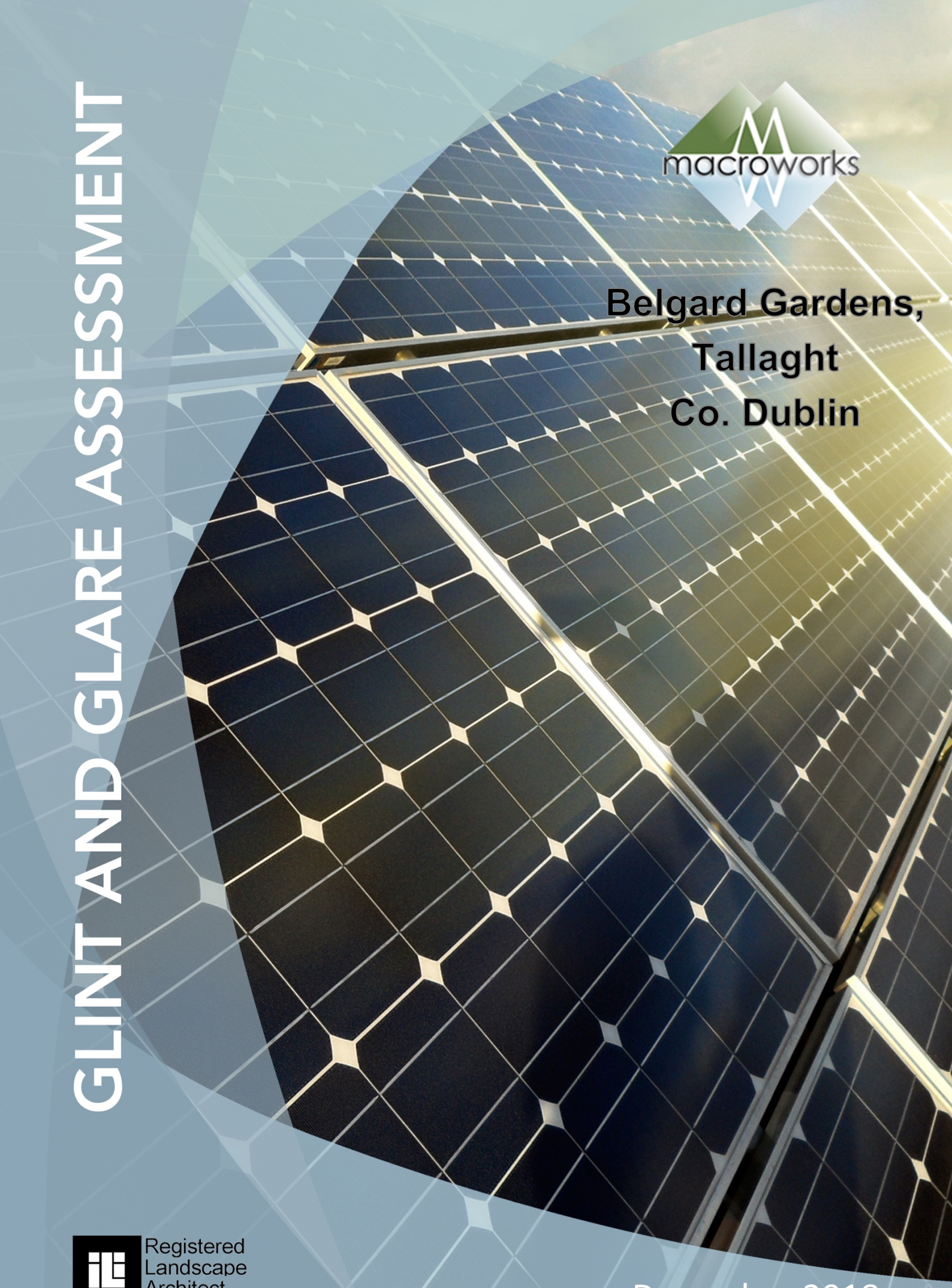
GLINT AND GLARE ASSESSMENT



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GLINT AND GLARE STUDY

Executive Summary

As part of the new Belgard Gardens residential development that is being proposed by Atlas GP Ltd in Tallaght, Co. Dublin, part of the design proposal includes for the placement of PV solar panel arrays atop a number of its roof sections as part of its sustainability requirement.

This study was carried out to determine the level of glint and glare, if any, that may result upon surrounding receptors should this rooftop installation proceed. These receptors included dwellings and routes as well as aviation receptors as defined by the Federal Aviation Authority (FAA). Further, at the behest of South Dublin County Council attention was also given to the possible effects on helicopter flight paths to and from Tallaght Hospital.

Based on our analysis of the PV panel layout we have determined that there is no potential for glare effects upon dwelling or route receptors in the surrounding environment. Further, it is unlikely that the rooftop solar PV installation, as proposed, would result in any glint or glare that would that would prove hazardous to aviation activities (based on analysis using FAA-accredited processes), be it with regard to the Tallaght Hospital helipad operations or with regard to the standard aviation receptors as defined by the FAA.

1.1 INTRODUCTION

Macro Works Ltd. was commissioned by Atlas GP Ltd to prepare this glint and glare report for a PV solar installation designed for the rooftop of the proposed Belgard Gardens residential development, Tallaght, Dublin 24.

1.1.1 Statement of Authority

Macro Works' relevant experience includes nineteen years of analysing the visual effects of a wide range of infrastructural and commercial development types. This experience includes numerous domestic and international wind and solar energy developments. The Glint and Glare analysis model used predominantly in this study was developed by Macro Works Ltd in conjunction with the Physics Department of the National University of Ireland, (NUI) Maynooth. This model has successfully replicated results from the Federal Aviation Authority (FAA) approved Solar Glare Hazard Analysis Tool (SGHAT) - the internationally recognised standard for glare analysis for the aviation industry. The Macro Works Glint and Glare analysis model has been utilised to assess the effects of glint and glare for more than 80 no. solar development sites throughout Ireland to date.

1.1.2 Scope of the Glint and Glare Assessment

During the course of pre-planning discussions with the planning authority, the issue of potential glint and glare was raised as a matter for consideration. The potential for hazardous reflectance effects to occur principally relate to the proposed skyward-facing roof-mounted solar PV panels and their potential to affect the aviation receptors at local aerodromes and Dublin Airport as well as the helicopter flight paths to and from Tallaght Hospital.

Guidance has been prepared by the US Federal Aviation Authority (FAA) to address the potential hazards that solar developments have upon aviation activities. The Solar Glare Hazard Analysis Tool (SGHAT) was developed in conjunction with the FAA in harmony with this guidance and has been made available as an online resource for use by international practitioners. Whilst in Ireland to date, this has typically been employed for the assessment of ground-based commercial solar installations of greater than 5MW in capacity (c. 11ha), it has also been used for a small number of roof-mounted installations that are considerably smaller.

The potential for adverse ocular impact on aviation receptors from reflectance emanating from the facades / windows in an urban environment is cumulatively very difficult to quantify, and consequently the FAA guidance does not stipulate a specific requirement for this aspect of a development to be assessed. Therefore, this does not feature as part this assessment.

Ground based receptors – surrounding roads and residences

An assessment of the PV panel layouts relative to building design shows that little or no visibility towards the panels is possible from street level, or indeed from surrounding residences. This is in part due to the tall nature of the development; the setback from the roof edges; the low nature of the PV panels being proposed (not more that 30cm above the roof surface level); and most significantly – the presence of a raised parapet about the roof perimeter (c. 45cm). While there is a roof section that slopes towards the south that may offer some glimpses of the tops of PV panels, the trajectory of the sun in an arc to the south ensures that any and all solar reflection will be directed to the north – where there will be no visibility of the PV panels. Further analysis of the glare potential of the proposed PV panels was deemed to be unnecessary.

1.1.3 Guidance and Best Practice

Guidance has been prepared by the Federal Aviation Authority to address the potential hazards that solar developments may pose to aviation activities, and this has been adopted for use by the Irish Aviation Authority.

By virtue of their efficiency, the intensity of reflected light from modern PV solar panels is deliberately low and currently equates with that of the reflection from still water, however, studies generally agree that there is still a potential for hazard or nuisance upon surrounding receptors.

1.1.3 Definitions

In their "Technical Guidance for Evaluating Selected Solar Technologies on Airports"[1] the FAA have defined the terms 'Glint' and 'Glare' as meaning;

Glint – *"A momentary flash of bright light"*

Glare – *"A continuous source of bright light"*

Glint and glare are essentially the reflection of sunlight from reflective surfaces. This study uses a multi-step process of elimination to determine which receptors have the potential to experience the effects of glint and glare. It then examines, using a computer generated geometric model, the times of the year and the times of the day such effects could occur. This is based on the relative angles between the sun, the panels and the receptors (receiving points of interest) throughout the year.

[1] Harris, Miller, Miller & Hanson Inc.. (November 2010). Technical Guidance for Evaluating Selected Solar Technologies on Airports; 3.1.2 Reflectivity. *Technical Guidance for Evaluating Selected Solar Technologies on Airports*. Available at: https://www.faa.gov/airports/environmental/policy_guidance/media/airport-solar-guide.pdf

1.1.4 General Nature of Reflectance from Photovoltaic Panels

In terms of reflectance, photovoltaic solar panels are by no means a highly reflective surface. They are designed to effectively absorb sunlight rather than to reflect it. Nonetheless, photovoltaic panels have a flat, polished surface, which results in the emission of some residual 'specular' reflectance (**Figure 1** refers). Several studies have shown that photovoltaic panels (as opposed to Concentrated Solar Power) have similar reflectance characteristics to water, which is much lower than the likes of glass, steel, snow and white concrete by comparison (**Figure 2** refers). Similar levels of reflectance can be commonly found in both urban and rural environments from surfaces such as roofs of industrial and farm buildings, lines of plastic mulch, wet road surfaces (**Figures 3 - 6** refer).

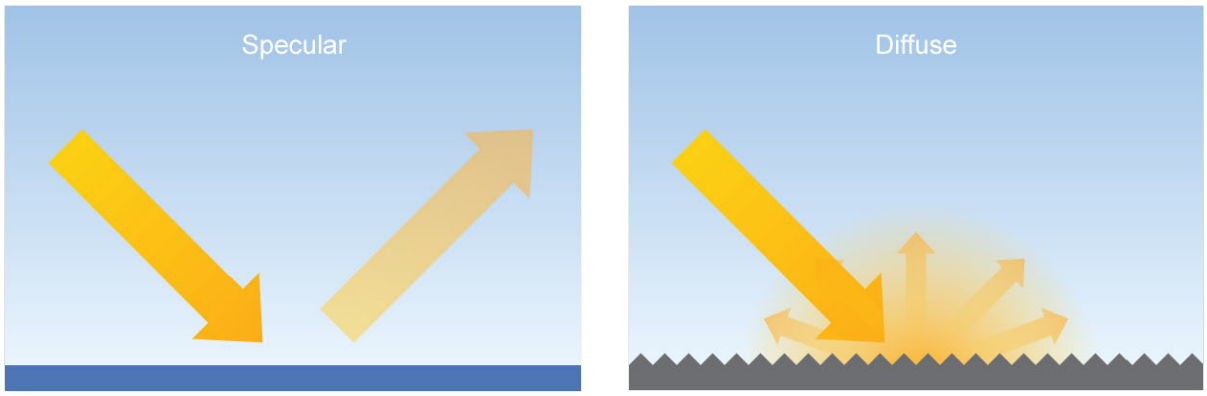

Figure 1 – Specular vs Diffuse reflection of light from polished and rough surfaces.

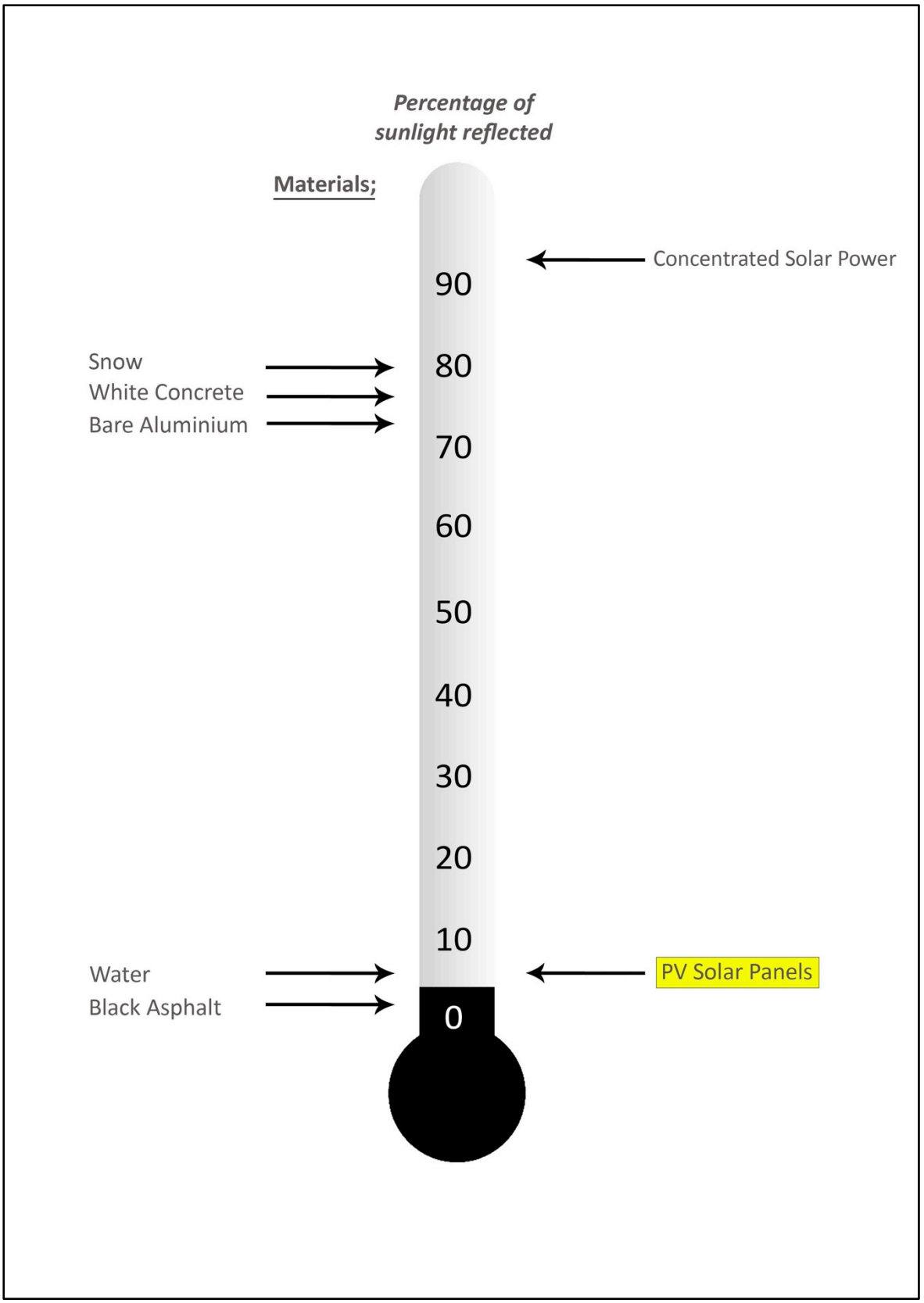

Figure 2 – Reflectivity produced by different surfaces in comparison to PV solar panels demonstrates that the amount of sunlight (measured in watts per meter (W/m2)) reflected from the surface of a solar panel is very similar to that of still water – far less than that of many surfaces commonly found in the environment, urban or rural.

Figure 3 – Similar level of reflectance (to photovoltaic panels) emanating from plastic ground covering in an Irish rural scenario.

Figure 4 – Higher levels of reflectance (to photovoltaic panels) emanate from green houses and roofs on agricultural buildings in an Irish rural scenario.

Figure 5 – Similar levels of reflectance (to photovoltaic panels) emanating from wet road surfaces.

Figure 6 – Higher levels of reflectance (to photovoltaic panels) emanating from glass green houses, windows and metallic roof surfaces in an Irish rural scenario.

Figure 7 – Higher levels of reflectance (to photovoltaic panels) emanating from powder coated corrugated metal roof surfaces in an Irish rural scenario.

1.1.5 Assessment Methodology

Macro Works' methodology for assessment of glint and glare upon aviation receptors follows a rational sequence of steps as set out below;

1. Identify airports and aerodromes required for assessment. The Irish Aviation Authority (IAA) requests that it be consulted on all applications for PV solar arrays within 10km of an airport or an aerodrome. The DAA separately requests referral of all projects falling within 15kms of either of the main Dublin or Cork Airports.

2. Identify and record the specific aviation receptors to be assessed. The Federal Aviation Authority (FAA) identifies runway approaches and air traffic control towers (ATCTs) as the main receptors of interest.

3. Analyse the potential for the identified aviation receptors to be affected by hazardous glint or glare using the FAA-approved Solar Glare Hazard Analysis Tool (SGHAT). This tool determines the likelihood for these receptors to experience glare and also whether it is likely to be hazardous. The 'hazard' threshold is a function of the type of receptor and the intensity of the solar reflectance - whether it is likely to cause temporary blindness.

4. Identify visual screening by landform and non-landform features such as buildings and trees. A SGHAT limitation is that it assumes that there is a line of sight between (a) the sun

and the PV solar installation and (b) the PV solar installation and the receptor. In the instance where SGHAT determines a potential for glare (hazardous or otherwise) it is important to carry out a separate visibility study to see if there are clear sight lines to the PV panels potentially causing the glare episodes. In the case of airborne receptors this can be established by standard viewshed analysis. For ground-based receptors, a more detailed assessment of glare is often required using Macro Works' proprietary glint and glare analysis model.

5. Where it is identified that glint and glare is causing a nuisance or hazard it is possible to implement specific measures to mitigate the effect. This may be achieved through the removal of offending panels; the reorientation of panels; or the erection of screening measures between the receptor and the installation.

Important Note

It must be emphasised at this point that all results, whether from FAA endorsed SGHAT software or our own proprietary software, are theoretical by default in that they assume that the sun is always shining and at full intensity. The results do not account for climate and inherent weather patterns that occur across the island of Ireland.

Records from the nearest meteorological station of Dublin Airport for the year 2017 indicate a mean daily duration of sunshine of 3.7 hours, or approximately 25% of daylight hours.
https://www2.metweb.ie/climate/available-data/historical-data

While we cannot correlate the historic random periods of sunshine with our predicted periods of glare, we can state with a high level of confidence that the weather, more precisely cloud cover, will account for a substantial reduction in all figures quoted in this report i.e. frequency and duration of glare periods.

In addition, atmospheric conditions such as haze, mist, fog and precipitation will all have the effect of both reducing the visibility of the site overall and reducing the intensity of any glare emanating from the proposed solar array.

1.1.6 Relevant Parameters of the Proposed Development

The proposed installation occupies the roof of the proposed Belgard Gardens development which is located just off Belgard Square North. The site is bounded to the northwest by Cookstown Industrial Estate, to the north by the Belgard Retail Park, to the east by the Belgard Rd (R133 regional road) and the Institute of Technology Tallaght. Belgard Square East (Local road L3034) runs along the southern perimeter of the site while Exchange Hall is situated to the west of the site. Tallaght General Hospital is located slightly further west immediately behind Exchange Hall. Luas Red Line terminates on Old Blessington Rd, just north of The Square Shopping Centre. The largest road in the vicinity is the N81 national secondary road (Tallaght Bypass) which passes to the south of The Square Shopping Centre, in an east-west orientation, approximately 550m to the south of the site. Other smaller roads in the area include Airton Rd (Local road L3001) to the north of the site and Cookstown Rd (Local road L3037) to the west.

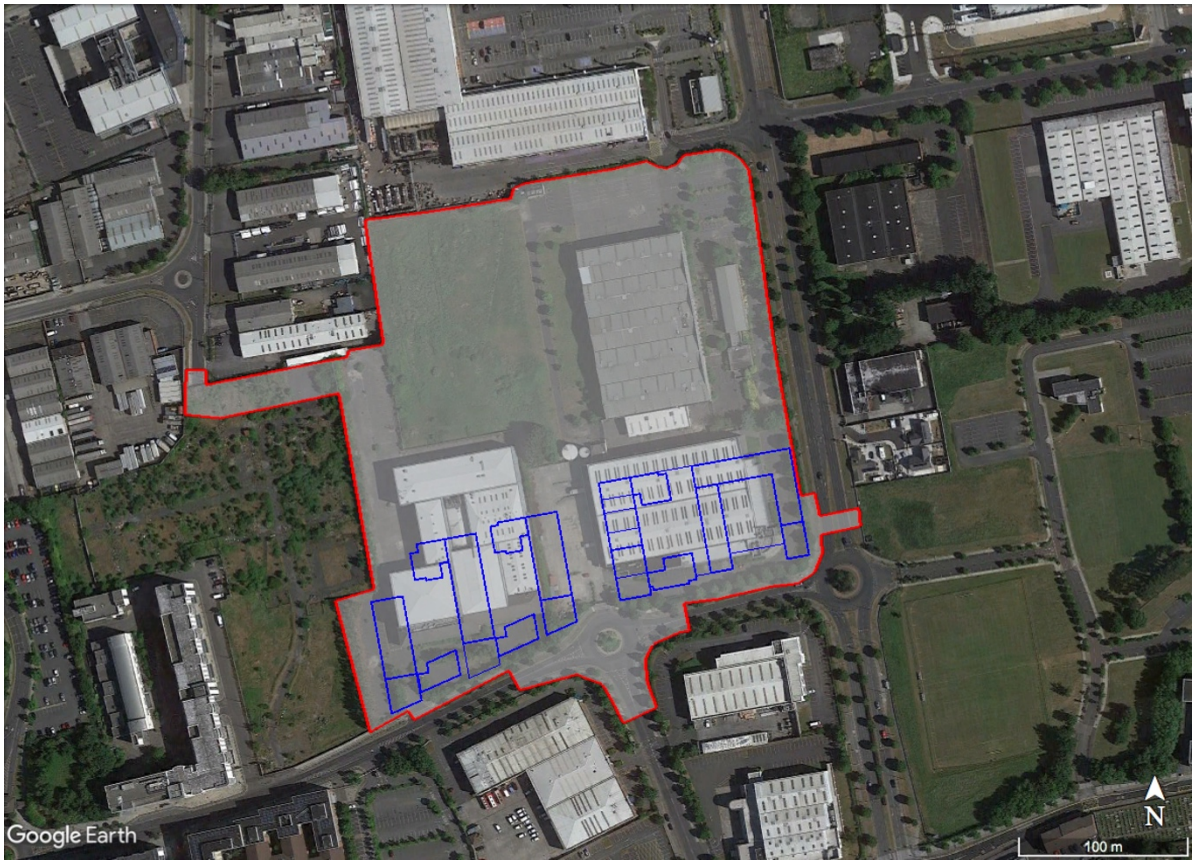

Figure 8 – Aerial view (Google Earth Pro) showing the location of the site of the proposed Belgard Gardens development (red outline) and the footprint of the buildings in phase 1 of the project (blue outline).

1.2 IDENTIFICATION OF RELEVANT RECEPTORS

In accordance with IAA guidance a 10km radius study area was established for the identification aviation receptors. Baldonnel Aerodrome, located within 10 km of the site (**Figure 9** refers) has been assessed by default. Weston Airport, located slightly outside the 10km zone has also been included for completeness.

As per a separate request by the DAA a 15km radius study area was established to test for proximity to either of the principal airports at Dublin or Cork. Dublin Airport is located slightly outside the 15km zone to the northeast, however, it has also been included for completeness (**Figure 9** refers).

Figure 9: Showing the location of the proposed PV solar array (centre icon), a standard 10km aviation study area (blue circle), a 15km study area specifically for the country's main Airport, and the nearest aviation receptors (yellow pins)

1.2.1.1 Baldonnel Aerodrome

Baldonnel Aerodrome is located 4.8km northwest of the proposed development. It hosts 2 operational runways - 05/23 and 11/29. The Air Traffic Control Tower (Ref: 1-ATCT in SGHAT) has a structural elevation approximately 9m above ground level.

1.2.1.2 Weston Airport

Weston Airport is located over 10.2km northwest of the proposed development. It hosts just 1 operational runway - 07/25. The Air Traffic Control Tower (Ref: 4-ATCT in SGHAT) has a structural elevation approximately 15m above ground level.

1.2.1.3 Dublin Airport

Dublin Airport is an international airport operated by the DAA. Its nearest runway is located approximately 15.3km northeast of the proposed development.

Runways: Dublin Airport hosts 2 operational runways 10/28 and 16/34. A 3rd runway is planned to the north (Reg. Ref. SID/01/09 / ABP PI06FPA0014) to help accommodate increasing passenger numbers that will run parallel to runway 10/28 to the south. This will render the 16/34 runway as a purely taxiing runway when operational (**Figure 10** refers). All 6 runway approaches will be assessed. This includes the recently proposed northern runway (approach 10L and 28R).

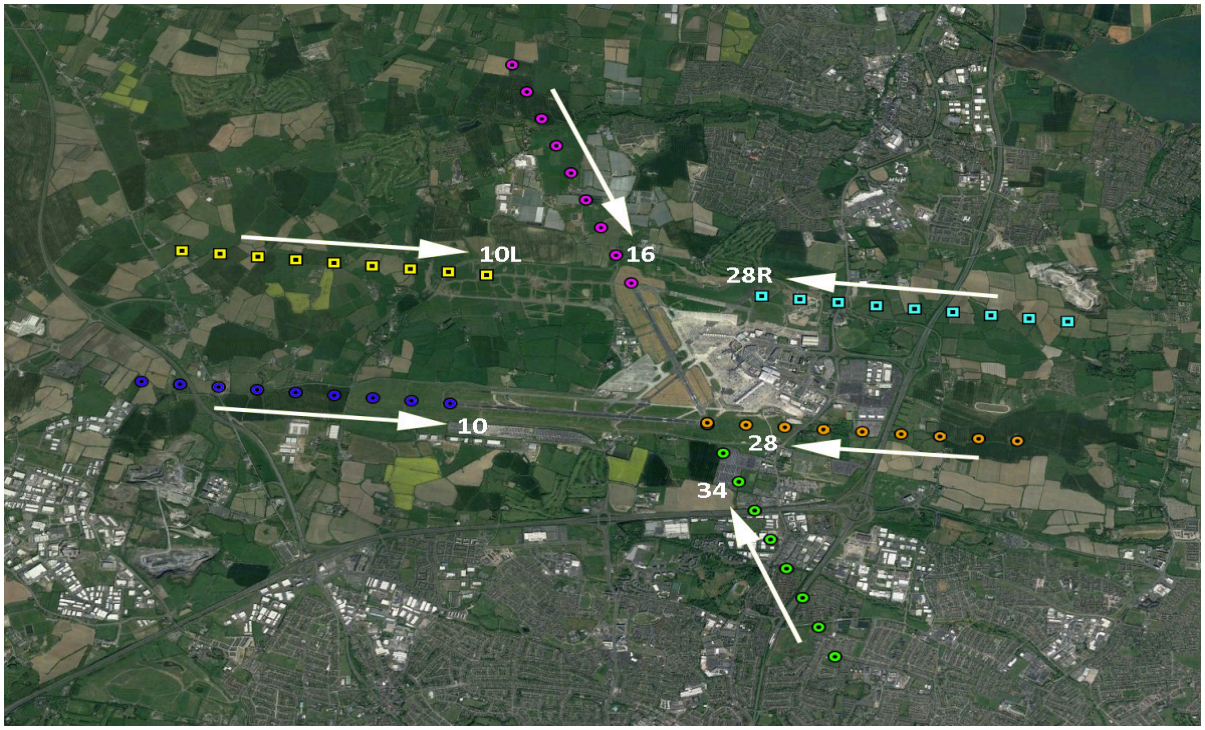

Figure 10: 2 mile approach lines to runways at Dublin Airport (at ¼ mile intervals) as assessed by SGHAT. Includes the proposed northern runways 10L and 28R.

Air Traffic Control Tower (ATCT): Dublin airport currently has a control tower to the west of the main terminal buildings (Ref: 3-ATCT in SGHAT). This has viewing height of 21.9m.

A new taller control tower (Ref: 2-ATCT in SGHAT) was recently granted planning by ABP (Reg. Ref 04/1755 ABP PL06F217429) to cater for greater traffic volumes and allow for visibility of the new

runway to the north, which would be screened from the smaller tower by airport buildings when built. This recently permitted, more modern tower is presently under construction and is due to be completed by 2020. This is considerably taller with a viewing height of 75.6m and is situated close by to the west of the existing tower (**Figure 8** refers).

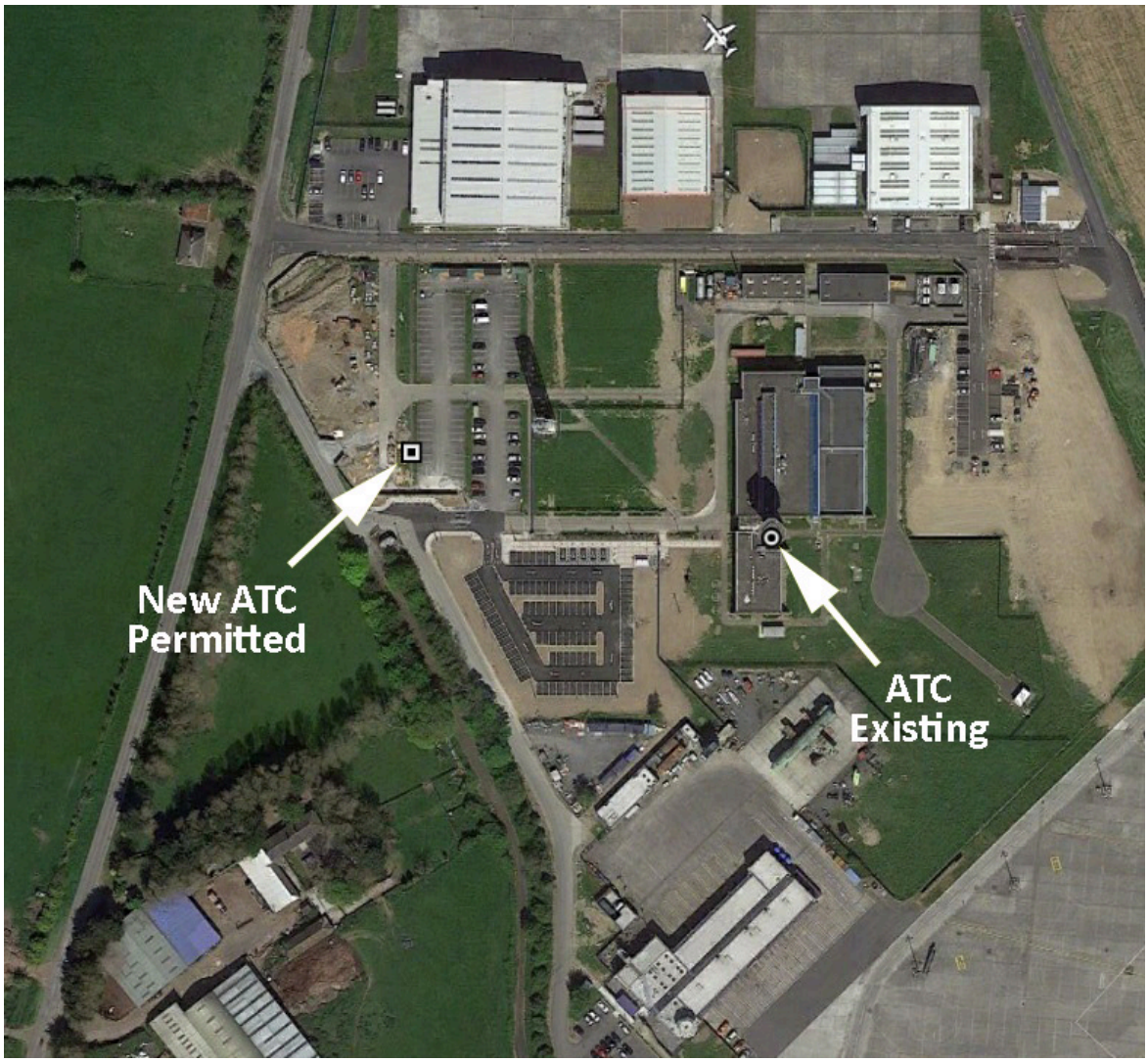

Figure 11: Air Traffic Control Towers at Dublin Airport - existing (3-ATCT) and newly permitted (2-ATCT)

1.3 RESULTS OF GLINT AND GLARE ASSESSMENT AT RECEPTORS

There is no guidance in Ireland as yet to specifically address the effects of solar panel reflections upon surrounding receptors, however, the Solar Glare Hazard Analysis Tool (SGHAT) produced by Sandia National Laboratories in the US is endorsed by the Federal Aviation Authority (FAA) *"as the standard for measuring the ocular impact of any proposed solar energy system on a federally-obligated airport*". This analysis tool is commonly regarded as the accepted industry standard by aviation authorities when considering the glint and glare effects upon aviation related receptors. For these reasons, SGHAT has been used as the default tool for glint and glare analysis for this part of the assessment. Results of the assessment of the aviation receptors is contained the SGHAT results in Appendix A and B.

1.3.1 Magnitude of Impact for Aviation Receptors

Within the FAA's interim policy, a 'Review of Solar Energy System Projects on Federally Obligated Airports'[2] it states that:

"To obtain FAA approval to revise an airport layout plan to depict a solar installation and/or a ''no objection'' to a Notice of Proposed Construction Form 7460–1, the airport sponsor will be required to demonstrate that the proposed solar energy system meets the following standards:

- *No potential for glint or glare in the existing or planned Airport Traffic Control Tower (ATCT) cab, and*

- *No potential for glare or ''**low potential for after-image**'' (shown in green in Figure 1 [**Figure 12** below refers]) along the final approach path for any existing landing threshold or future landing thresholds (including any planned interim phases of the landing thresholds) as shown on the current FAA-approved Airport Layout Plan (ALP). The final approach path is defined as two (2) miles from fifty (50) feet above the landing threshold using a standard three (3) degree glidepath."*

The SGHAT was designed to determine whether a proposed solar energy project would result in the potential for ocular impact as depicted on the Solar Glare Hazard Analysis Plot (**Figure 12** refers). The SGHAT website describes the tool as follows:

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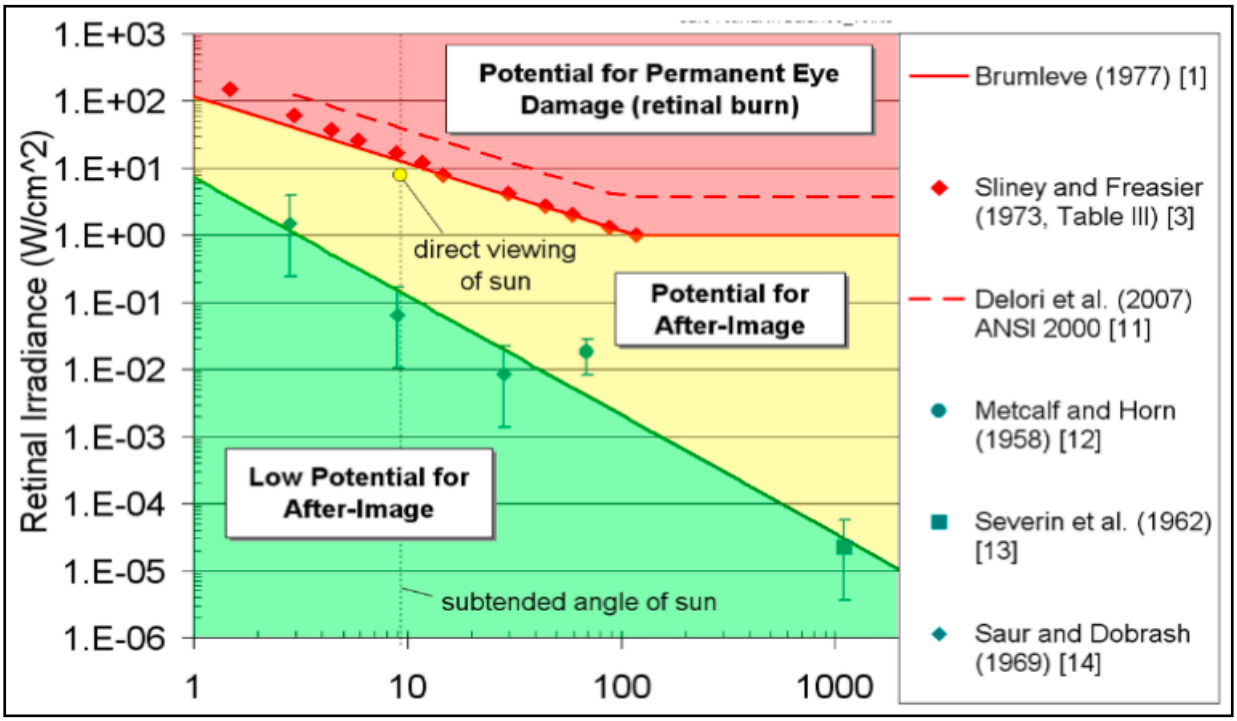
[2] Federal Aviation Administration (FAA). (2013). Department of Transportation - Federal Aviation Administration. *Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports*. Vol 78 (No 205), 63276-63279.

"This tool determines when and where solar glare can occur throughout the year from a user-specified PV array as viewed from user-prescribed observation points. The potential ocular impact from the observed glare is also determined..."

SGHAT analyses ocular impact over the entire calendar year in one (1) minute intervals from when the sun rises above the horizon until the sun sets below the horizon. One of the principal outputs from the SGHAT report is a glare plot per receptor that indicates the time of day and days per year that glare has the potential to occur. The SGHAT plot is coloured according to a legend that indicates the intensity of the glare per period and whether it is harmful to human vision. SGHAT plot classifies the intensity of ocular impact as either Green Glare, Yellow Glare or Red Glare. These colour classifications are equivalent and synonymous to the FAA's definitions regarding the level of ocular impact (**Figure 12** refers). E.g. 'Green Glare' in the SGHAT is equivalent to the FAA's *"low potential for after-image','* and so forth. These correlations are illustrated on the Solar Glare Hazard Analysis Plot in **Figure 12**.



Solar Glare Ocular Hazard Plot: The potential ocular hazard from solar glare is a function of retinal irradiance and the subtended angle (size/distance) of the glare source. It should be noted that the ratio of spectrally weighted solar illuminance to solar irradiance at the earth's surface yields a conversion factor of ~100 lumens/W. Plot adapted from Ho et al., 2011.

Chart References: Ho, C.K., C.M. Ghanbari, and R.B. Diver, 2011, Methodology to Assess Potential Glint and Glare Hazards from Concentrating Solar Power Plants: Analytical Models and Experimental Validation, J. Solar Energy Engineering, August 2011, Vol. 133, 031021-1 – 031021-9.

Figure 12 – *Figure 1* from the FAA Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports

1.4 ASSESSMENT OF GLINT AND GLARE EFFECTS – STANDARD AVIATION RECEPTORS

1.4.1 SGHAT Results

Two separate SGHAT analyses were carried out on the identified aviation receptors. One to account for the east facing PV panels (Appendix A) and the other to account for the west facing PV panels (Appendix B) in the proposed array. Examination of the SGHAT results show that there is no potential glint or glare to occur whatsoever at Weston Airport. There exists, however, the theoretical potential for some low levels of reflectance to occur along the runway approaches at Baldonnel Aerodrome and Dublin Airport.

Weston Airport

Results from SGHAT (Appendix A and B) indicate that there is no potential for glare of any type possible at either the runway or the air traffic control tower at Weston Airport (identified as '4-ATCT' in the SGHAT analysis report).

Baldonnel Aerodrome

Results from SGHAT (Appendix A and B) indicate the potential for 'Green Glare' i.e. glare with a ***'low potential for temporary after image,'*** to occur along all of the runway approaches at Baldonnel Aerodrome. This '*Low potential for temporary after image'* intensity type is considered by the FAA to be an acceptable level of reflectance effect. There was ***'No Glare Found'*** at the air traffic control tower (identified as '1-ATCT' in the SGHAT analysis report).

Dublin Airport

Results from SGHAT (Appendix A and B) indicate ***'No Glare Found'*** along the approaches to Runways 23 and 29 and the potential for 'Green Glare' i.e. glare with a ***'low potential for temporary after image,'*** to occur along all of the remaining runway approaches at Dublin Airport. This '*Low potential for temporary after image'* intensity type is considered by the FAA to be an acceptable level of reflectance effect. There was ***'No Glare Found'*** at either of the air traffic control towers (the Existing ATCT is identified as '3-ATCT' and the New ATCT is identified as '2-ATCT' in the SGHAT analysis report).

A summary of these results in Appendix A and B are shown in Table 1 and Table 2 below:

Table 1 – SGHAT results summary (east facing PV panels)

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	PASS	Flight path receptor(s) do not receive yellow glare
ATCT(s)	PASS	Receptor(s) marked as ATCT do not receive glare

Table 2 – SGHAT results summary (west facing PV panels)

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	PASS	Flight path receptor(s) do not receive yellow glare
ATCT(s)	PASS	Receptor(s) marked as ATCT do not receive glare

The SGHAT analysis shows that there is no potential for hazard effects along the runway approaches at Weston Airport, Baldonnel Aerodrome or Dublin Airport. Additionally they show that there is no potential for any glare whatsoever to occur at any of the existing the Air Traffic Control Towers or at the permitted new ATCT at Dublin Airport.

1.5 ASSESSMENT OF GLINT AND GLARE EFFECTS – ADDITIONAL AVIATION RECEPTORS

In addition to the standard aviation receptors of surrounding airports, South Dublin County Council requested that an assessment be undertaken in respect of the helipad within the grounds of Tallaght hospital which is situated less than 500m to the west of the proposed PV panels.

In the absence of specific flight path information for the helicopters that land and take off from this helipad and given the potential random trajectory of helicopter destination and arrival flights to an important city hospital it was decided to cover a broad range of possibilities by applying a comprehensive network of aerial receptor points in all directions from the helipad, at multiple height intervals (to 200m AGL), to a distance of 1,500m radius from the helipad. It is intended that this will serve for the evaluation of all flight scenarios to and from the hospital.

1.5.1 Helipad Glint and Glare Analysis

Macro Works proprietary glint and glare software was used in order to identify the pattern of potential glare in the skies within the study area. The first step was to determine the areas where there is the potential for glare to occur and to identify the date, time and duration of all potential reflectance episodes. Receptor points were positioned at equal 250m spacings along vectors centred on the helipad and which spread out towards the eight cardinal points / directions (**Figure 14** refers). Analyses were carried out at each Receptor Point at 10 altitude intervals (10 x 20m intervals) from 128m ASL to 328m ASL. 128m is 25m above ground level at the helipad (103m ASL), the level at which glare starts to occur. The results of these analysis at the 10 various altitudes are contained in Appendix C and D.

Figure 14 – Receptor Points for Analysis – layout centred on the helipad at Tallaght hospital

1.5.1.1 Assessment of Helipad Glint and Glare Results

The output data of the analyses indicate that the potential for reflectance is limited to the northern half of the study area. This is expected given that the orientation and tilt of the PV panels and because the arc of the sun is to the south. This analysis results show that the major frequency and duration of the glare periods is concentrated along the Northeast line within a distance of 750m at altitudes of 150m and above. For the other directions West, Northwest, North and East the total glare is comparatively small and is spread across infrequent episodes with daily durations (minutes) of glare in the single digits.

1.5.2 SGHAT Analysis of the Potentially Affected Receptor Points

In an effort to qualify the hazard potential of the glare episodes, all of the points experiencing glare were run separately through SGHAT. While not regular receptors as defined by FAA guidance, it was assumed that a similar hazard intensity classification would apply to the helicopter flight points as to that of a passenger aircraft approaching a runway. As previously mentioned the FAA considers that a glare with a 'Green Glare' level intensity does not have the potential to leave an 'after-image' and is therefore considered to be of an acceptable level for pilots engaged in landing and take-off manoeuvres. 'Yellow' glare on the contrary is deemed to be hazardous.

The SGHAT analysis was undertaken on the 34 Receptor Points in the northern half of the study area and immediately around the helipad. These were the ones demonstrated to have the potential to experience glare episodes in our first round of analysis. In the SGHAT software, Observation Points were placed in the same location as the Receptor Points used in the Glint and Glare analysis model (the same x and y coordinates) (**Figure 15** refers). The SGHAT analysis was carried out at a representative selection of elevations; 168m, 248m and 328m Above Sea Level (ASL). Two separate SGHAT reports were generated at each altitude, one to account for the east facing PV panels and the other to account for the west facing PV panels within the proposed array. The results of these SGHAT reports are contained in Appendix E.

Figure 15 – Location of the Observation Points selected in the SGHAT software.

1.5.2.1 Assessment of SGHAT Analysis Results for the Potentially Affected Receptor Points

The results of the SGHAT analysis show that the intensity level of all potential episodes of reflectance will not exceed a level greater than 'Green Glare' at any Observation Point examined at the selected representative heights, i.e. ocular impact will be no greater than a *"low potential for temporary after image"*. The results of the SGHAT analysis at the selected representative heights can be extrapolated to cover all altitude intervals from 128m ASL to 328m ASL. **It is concluded that the intensity of the predicted reflectance, as a result of the proposed solar array, is acceptable by FAA standards.**

The SGHAT analysis shows that while there is the potential for very short glare episodes along flight paths approaching from the north, these will be fleeting and, given the small scale of the installation, are unlikely to pose any hazard to flight, landing and take-off operations.

1.5.3 Direct Mitigating Factors

It is important to note that the user manual for Sandia National Laboratories SGHAT states *"SGHAT does not consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc."* hence it is likely that impacts will be far lower than predicted due to intervening screening. The low lying nature of the proposed panels (0.3m max height) coupled with the presence of a comparatively high parapet around the roof perimeter (0.45m) will serve to substantially screen the panels from oblique views and reduce predicted glare episodes.

It is also important to highlight that the SGHAT does not handle the intricacies of small developments efficiently. Therefore, the proposed solar PV panel areas were considered in their entirety for east-facing panels and then again in their entirety for the west-facing panels. The reality is that half the panels will be facing east while the other half will be facing west. This means that all predicted glare figures are substantially higher than what is likely to occur as each panel orientation occupies only half of the total panel area analysed.

As typical for many modern solar PV installations the panels are glazed with an anti-reflective coating. This has the effect of substantially reducing the intensity of the glare.

1.5.4 Other Mitigating Factors of Note

The user manual for SGHAT also points out that *"to minimize unexpected glare, windows of air traffic control towers and airplane cockpits are coated with anti-reflective glazing and operators will wear polarized eye wear."* [3]

The Solar Trade Associations (STA) report is the most up-to-date compilation of analysis relating to glint and glare and its impacts on aircraft and airports. In turn, this references the Federal Aviation Authority's report - a 'Technical Guidance for Evaluating Selected Solar Technologies on Airports' relating to the effects of glint and glare on air traffic control towers and on pilots of aircraft. The STA report also compiles a list of experts in the field of glint and glare, all of whom agree that there have been no significant issues of glint and glare for pilots and air traffic controllers arising from PV solar installations. The majority of them also note that they have never seen a solar site refused planning on the grounds of glint and glare. The report also lists 43 airports from around the world that have large solar PV installations next to the runway or under their flight paths and that this is considered to be only a small fraction of such facilities that lie in close proximity to airports. The report concludes, *"the STA do not believe that there is cause for concern in relation to the impact of glint and glare from solar PV on aviation and airports"*. It should be noted that Crookedstone Solar Farm, which is located in County Antrim is situated 600m from Belfast International Airport's

[3] Harris, Miller, Miller & Hanson Inc.. (November 2010). Technical Guidance for Evaluating Selected Solar Technologies on Airports; 3.1.2 Reflec ivity . *Technical Guidance for Evaluating Selected Solar Technologies on Airports*. Available at: https://www.faa.gov/airports/environmental/policy_guidance/media/airport-solar-guide.pdf

primary runway (**Figure 16** refers). To date, there appears to have been no issues raised relating to glint and glare.

Figure 16 – Belfast International Airports proximity to Crookedstone solar Farm[4]

1.6 OVERALL CONCLUSION

The SGHAT results for the standard aviation receptors show that there is no potential for hazard effects along the runway approaches at Weston Airport, Baldonnel Aerodrome or Dublin Airport. Additionally they show that there is no potential for any glare whatsoever to occur at any of the existing Air Traffic Control Towers or at the permitted new ATCT at Dublin Airport. Furthermore, efforts have been made to minimise the potential for glare impacts upon the helipad activities at Tallaght Hospital. Any glare occurring in the airspace above the helipad has been determined (using FAA-accredited processes) to have an intensity level that falls within typically acceptable limits for aircraft landing activities (based on FAA guidance for such solar installations near airports).

[4] *Lightsource, (2016), Crookedstone Solar Farm [ONLINE]. Available at: http://www.lightsource-re.ie/2016/05/18/irelands-first-large-scale-solar-farm-connected/ [Accessed 2 December 2016].*

APPENDIX A:

SGHAT RESULTS – STANDARD AVIATION RECEPTORS (EAST FACING PV PANELS)

Note:

The SGHAT Air Traffic Control Tower references are as follows:

1-ATCT: Existing tower at Baldonnel Aerodrome

2-ATCT: New tower under construction at Dublin Airport

3-ATCT: Existing tower at Dublin Airport

4-ATCT: Existing tower at Weston Airport

FORGESOLAR GLARE ANALYSIS

Project: **Dublin Airport**
Site configuration: **Belgard Gardens 80 Deg**
Analysis conducted by Nikolas Hennessy (nik@macroworks.ie) at 14:26 on 22 Oct, 2018.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	PASS	Flight path receptor(s) do not receive yellow glare
ATCT(s)	PASS	Receptor(s) marked as ATCT do not receive glare

Default glare analysis and observer eye characteristics are as follows:

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

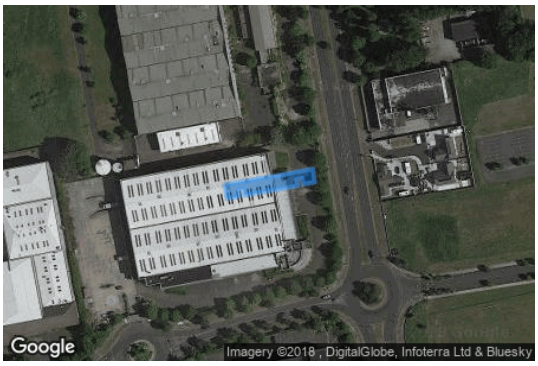
SITE CONFIGURATION

Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 18877.2021

PV Array(s)

Name: Panel Area 1
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 80.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.291307	-6.368810	100.00	19.00	119.00
2	53.291235	-6.368792	99.00	20.00	119.00
3	53.291223	-6.368898	99.00	20.00	119.00
4	53.291257	-6.368908	99.00	20.00	119.00
5	53.291251	-6.368960	99.00	20.00	119.00
6	53.291216	-6.368946	99.00	20.00	119.00
7	53.291164	-6.369432	99.00	20.00	119.00
8	53.291198	-6.369439	99.00	20.00	119.00
9	53.291193	-6.369491	99.00	20.00	119.00
10	53.291159	-6.369480	99.00	20.00	119.00
11	53.291147	-6.369587	99.00	20.00	119.00
12	53.291220	-6.369611	99.00	20.00	119.00
13	53.291307	-6.368810	99.00	20.00	119.00

Name: Panel Area 2
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 80.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.290775	-6.370087	99.00	26.00	125.00
2	53.290669	-6.370053	99.00	26.00	125.00
3	53.290640	-6.370311	99.00	26.00	125.00
4	53.290746	-6.370343	99.00	26.00	125.00
5	53.290762	-6.370204	99.00	26.00	125.00
6	53.290741	-6.370199	99.00	26.00	125.00
7	53.290744	-6.370156	99.00	26.00	125.00
8	53.290765	-6.370162	99.00	26.00	125.00
9	53.290775	-6.370087	99.00	26.00	125.00

Name: Panel Area 3
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 80.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.290898	-6.370123	99.00	28.00	127.00
2	53.290870	-6.370380	99.00	28.00	127.00
3	53.290929	-6.370397	99.00	28.00	127.00
4	53.290957	-6.370141	99.00	28.00	127.00
5	53.290898	-6.370123	99.00	28.00	127.00

Name: Panel Area 4
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 80.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.291080	-6.370180	99.00	26.00	125.00
2	53.291052	-6.370434	99.00	26.00	125.00
3	53.291084	-6.370445	99.00	26.00	125.00
4	53.291112	-6.370191	99.00	26.00	125.00
5	53.291080	-6.370180	99.00	26.00	125.00

Name: Panel Area 5
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 80.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.291117	-6.370191	99.00	23.00	122.00
2	53.291089	-6.370446	99.00	23.00	122.00
3	53.291106	-6.370451	99.00	23.00	122.00
4	53.291135	-6.370196	99.00	23.00	122.00
5	53.291117	-6.370191	99.00	23.00	122.00

Name: Panel Area 6
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 80.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.290961	-6.370870	100.50	21.70	122.20
2	53.290799	-6.370821	100.50	21.70	122.20
3	53.290797	-6.370843	100.50	21.70	122.20
4	53.290643	-6.370796	100.50	21.70	122.20
5	53.290625	-6.370966	100.50	21.70	122.20
6	53.290843	-6.371033	100.50	21.70	122.20
7	53.290852	-6.370959	100.50	21.70	122.20
8	53.290881	-6.370968	100.50	21.70	122.20
9	53.290873	-6.371041	100.50	21.70	122.20
10	53.290939	-6.371062	100.50	21.70	122.20
11	53.290961	-6.370870	100.50	21.70	122.20

Name: Panel Area 7
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 80.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.290815	-6.371603	101.00	21.20	122.20
2	53.290462	-6.371495	101.00	21.20	122.20
3	53.290444	-6.371664	101.00	21.20	122.20
4	53.290701	-6.371743	101.00	21.20	122.20
5	53.290709	-6.371669	101.00	21.20	122.20
6	53.290738	-6.371678	101.00	21.20	122.20
7	53.290730	-6.371751	101.00	21.20	122.20
8	53.290797	-6.371770	101.00	21.20	122.20
9	53.290815	-6.371603	101.00	21.20	122.20

Flight Path Receptor(s)

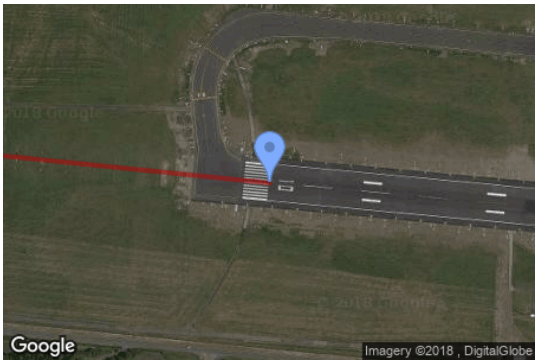
Name: Baldonnel 05 Runway
Description: None
Threshold height: 15 m
Direction: 41.3°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.293830	-6.453465	98.30	15.20	113.50
Two-mile	53.272113	-6.485435	154.40	127.80	282.20

Name: Baldonnel 10L Runway
Description: None
Threshold height: 15 m
Direction: 95.8°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.436880	-6.280253	71.90	15.20	87.10
Two-mile	53.439822	-6.328592	74.90	180.90	255.80

Name: Baldonnel 10 Runway
Description: None
Threshold height: 15 m
Direction: 95.8°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

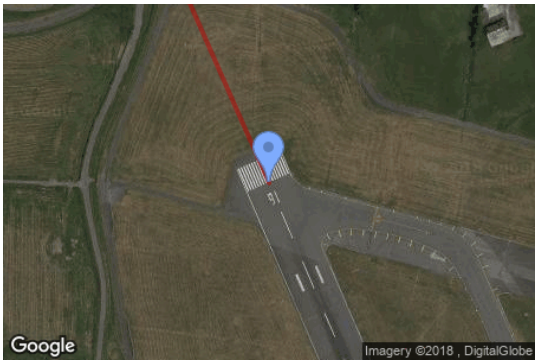


Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.422405	-6.289520	74.00	15.30	89.30
Two-mile	53.425327	-6.337846	80.30	177.60	257.90

Name: Baldonnel 11 Runway
Description: None
Threshold height: 15 m
Direction: 101.8°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.304622	-6.468287	86.32	15.30	101.62
Two-mile	53.310534	-6.515705	73.64	196.60	270.24

Name: Dublin 16 Runway
Description: None
Threshold height: 15 m
Direction: 156.1°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.436699	-6.261764	66.50	15.20	81.70
Two-mile	53.463138	-6.281428	69.70	180.70	250.40

Name: Dublin 23 Runway
Description: None
Threshold height: 15 m
Direction: 220.9°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.303267	-6.439788	93.40	15.20	108.60
Two-mile	53.325107	-6.408047	62.50	214.80	277.30

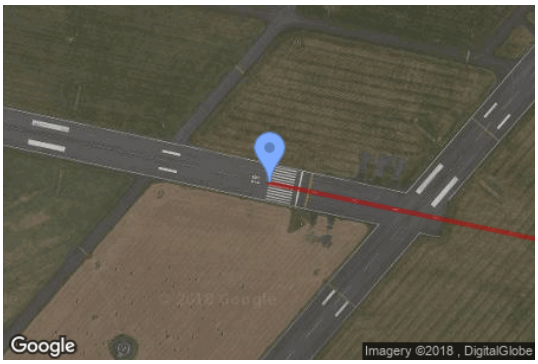
Name: Dublin 28R Runway
Description: None
Threshold height: 15 m
Direction: 275.9°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.435084	-6.240975	65.50	15.30	80.80
Two-mile	53.432097	-6.192645	34.00	215.50	249.50

Name: Dublin 28 Runway
Description: None
Threshold height: 15 m
Direction: 275.5°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

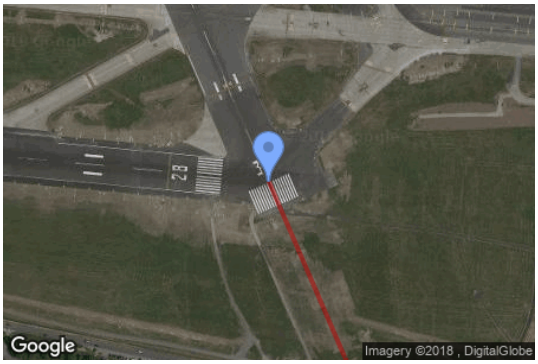
Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.420299	-6.251111	62.00	15.20	77.20
Two-mile	53.417517	-6.202763	41.90	204.00	245.90

Name: Dublin 29 Runway
Description: None
Threshold height: 15 m
Direction: 281.8°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.301696	-6.445153	96.10	15.20	111.30
Two-mile	53.295759	-6.397747	106.20	173.80	280.00

Name: Dublin 34 Runway
Description: None
Threshold height: 15 m
Direction: 336.6°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.420211	-6.249810	62.20	15.30	77.50
Two-mile	53.393680	-6.230504	49.00	197.10	246.10

Name: Weston 07 Runway
Description:
Threshold height: 15 m
Direction: 63.2°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.350769	-6.493327	47.50	15.24	62.74
Two-mile	53.337746	-6.536623	54.61	176.82	231.43

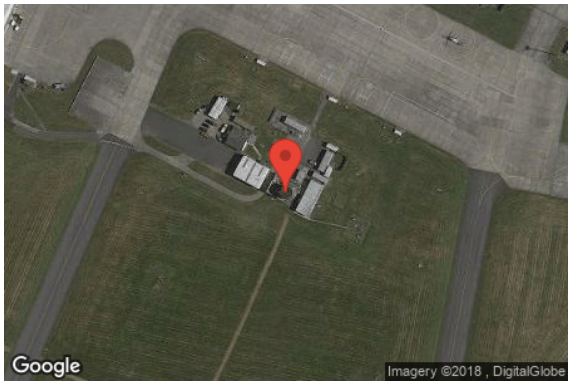
Name: Weston 25 Runway
Description:
Threshold height: 15 m
Direction: 243.3°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.354032	-6.482615	46.75	15.24	61.99
Two-mile	53.367023	-6.439289	30.12	200.55	230.68

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
1-ATCT	1	53.305496	-6.441790	93.50	9.00
2-ATCT	2	53.428489	-6.262201	65.90	21.90
3-ATCT	3	53.428937	-6.264259	65.60	75.60
4-ATCT	4	53.355640	-6.489488	49.45	15.00

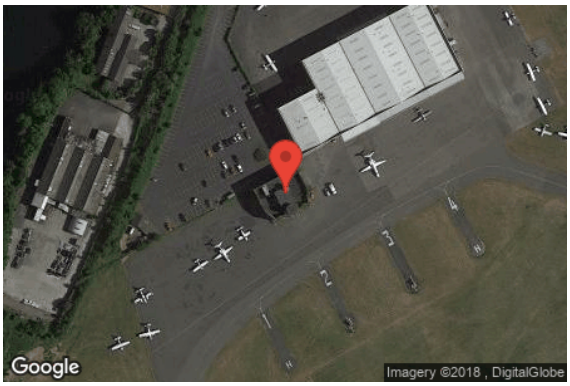
Map image of 1-ATCT



Map image of 2-ATCT

Map image of 3-ATCT

Map image of 4-ATCT



GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Panel Area 1	10.0	80.0	417	0	-
Panel Area 2	10.0	80.0	1,033	0	-
Panel Area 3	10.0	80.0	604	0	-
Panel Area 4	10.0	80.0	447	0	-
Panel Area 5	10.0	80.0	383	0	-
Panel Area 6	10.0	80.0	348	0	-
Panel Area 7	10.0	80.0	879	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
Baldonnel 05 Runway	0	0
Baldonnel 10L Runway	64	0
Baldonnel 10 Runway	50	0
Baldonnel 11 Runway	0	0
Dublin 16 Runway	874	0
Dublin 23 Runway	0	0
Dublin 28R Runway	1451	0
Dublin 28 Runway	1417	0
Dublin 29 Runway	0	0
Dublin 34 Runway	255	0
Weston 07 Runway	0	0
Weston 25 Runway	0	0
1-ATCT	0	0
2-ATCT	0	0
3-ATCT	0	0
4-ATCT	0	0

Results for: Panel Area 1

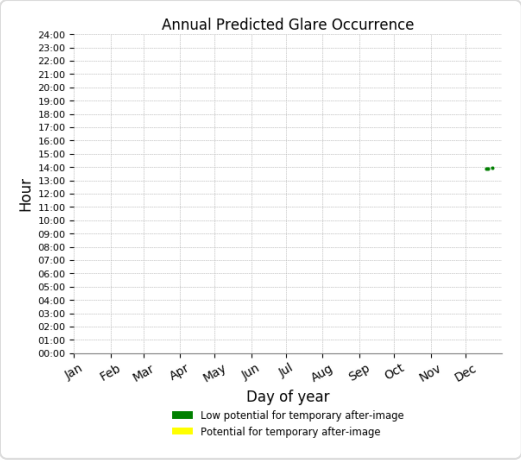
Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 05 Runway	0	0
Baldonnel 10L Runway	3	0
Baldonnel 10 Runway	1	0
Baldonnel 11 Runway	0	0
Dublin 16 Runway	100	0
Dublin 23 Runway	0	0
Dublin 28R Runway	144	0
Dublin 28 Runway	140	0
Dublin 29 Runway	0	0
Dublin 34 Runway	29	0
Weston 07 Runway	0	0
Weston 25 Runway	0	0
1-ATCT	0	0
2-ATCT	0	0
3-ATCT	0	0
4-ATCT	0	0

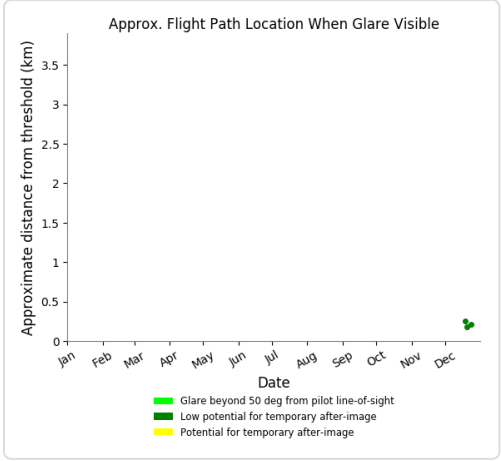
Flight Path: Baldonnel 05 Runway

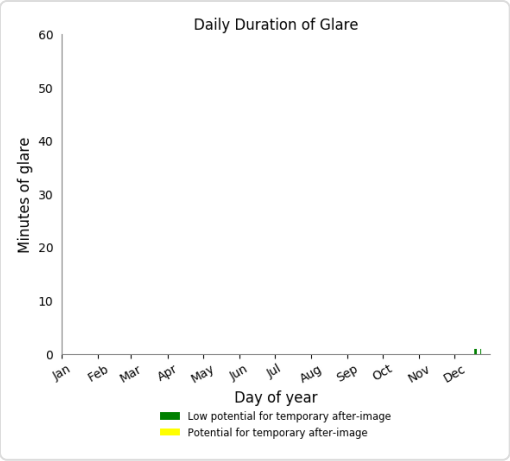
0 minutes of yellow glare
0 minutes of green glare

Flight Path: Baldonnel 10L Runway

0 minutes of yellow glare
3 minutes of green glare



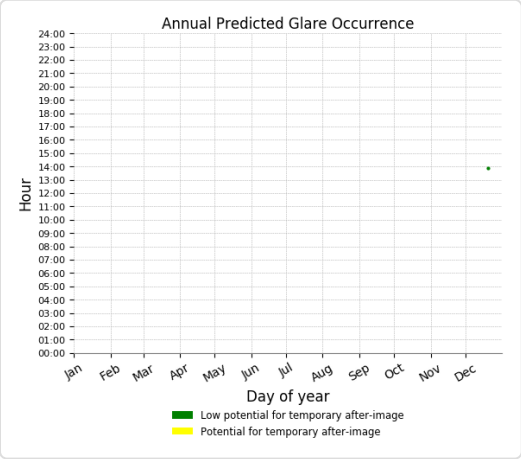


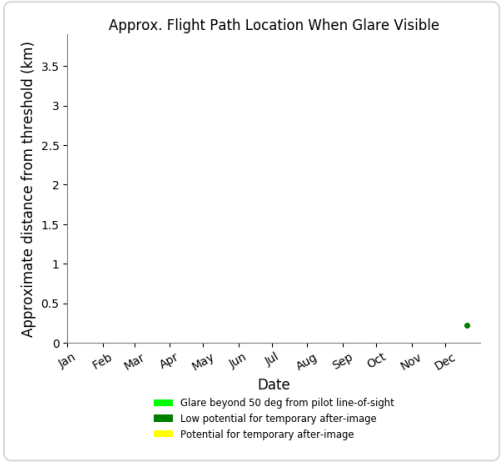


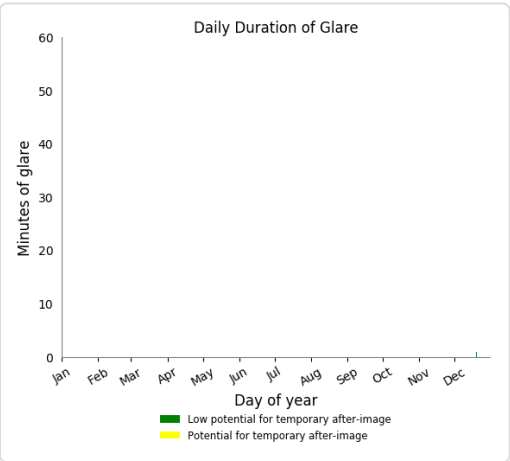
Flight Path: Baldonnel 10 Runway

0 minutes of yellow glare

1 minutes of green glare







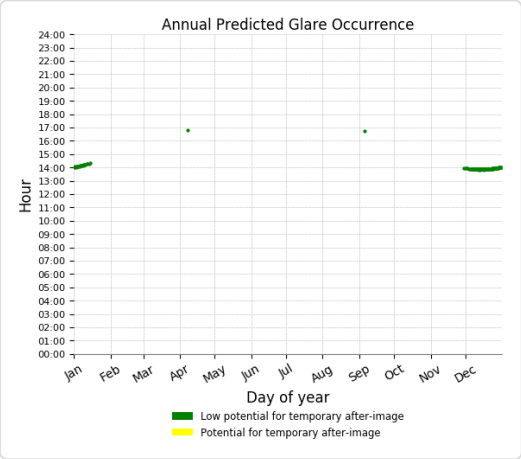
Flight Path: Baldonnel 11 Runway

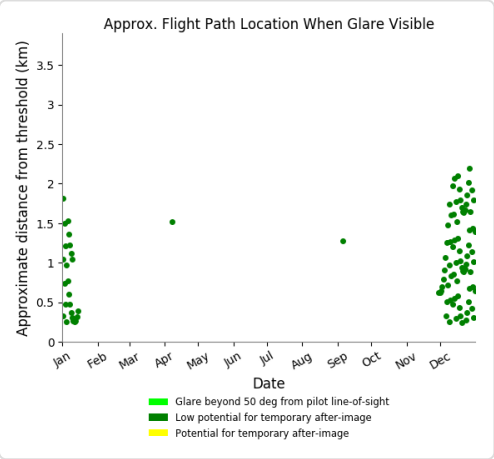
0 minutes of yellow glare

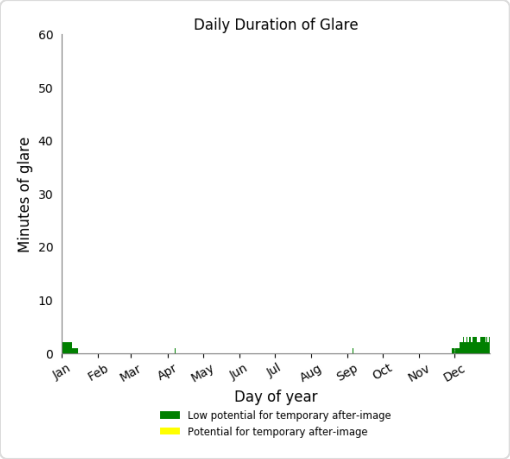
0 minutes of green glare

Flight Path: Dublin 16 Runway

0 minutes of yellow glare
100 minutes of green glare





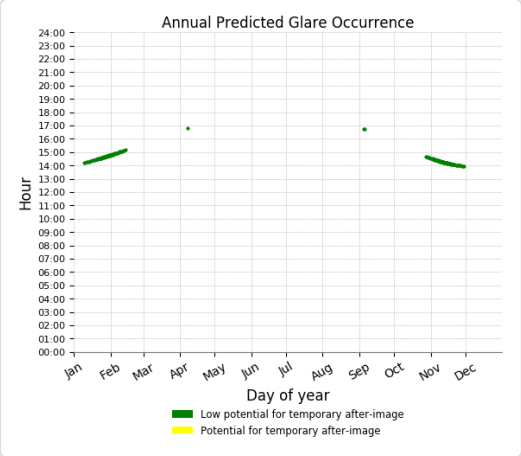


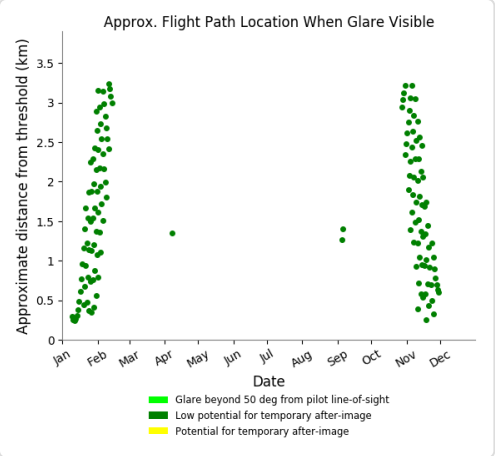
Flight Path: Dublin 23 Runway

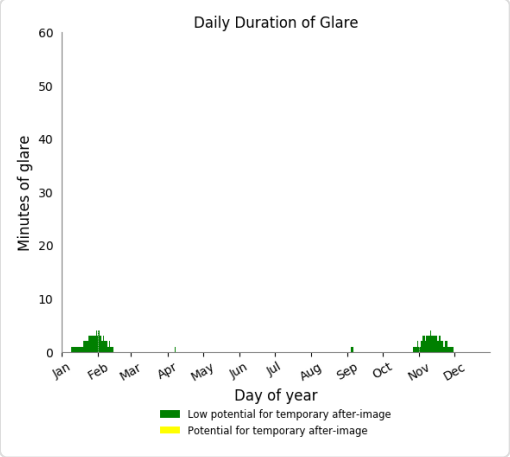
0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28R Runway

0 minutes of yellow glare
144 minutes of green glare



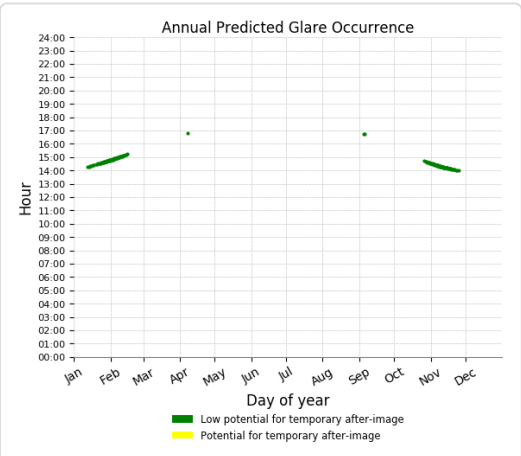


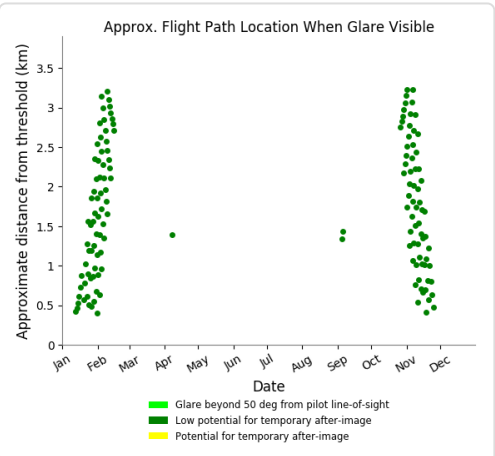


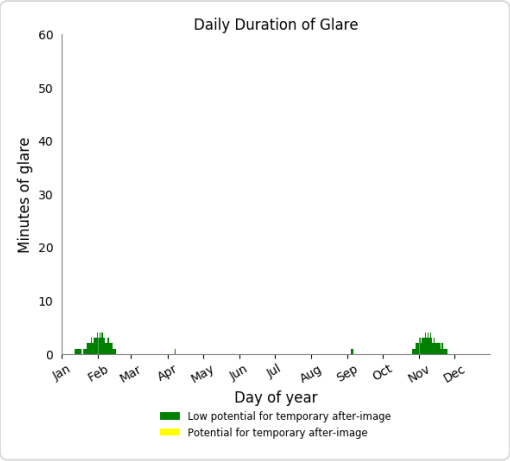
Flight Path: Dublin 28 Runway

0 minutes of yellow glare

140 minutes of green glare







Flight Path: Dublin 29 Runway

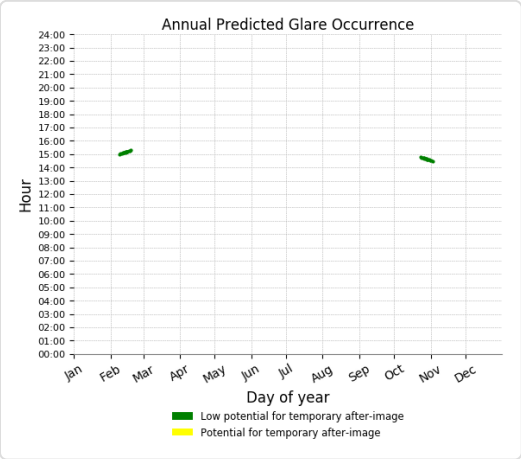
0 minutes of yellow glare

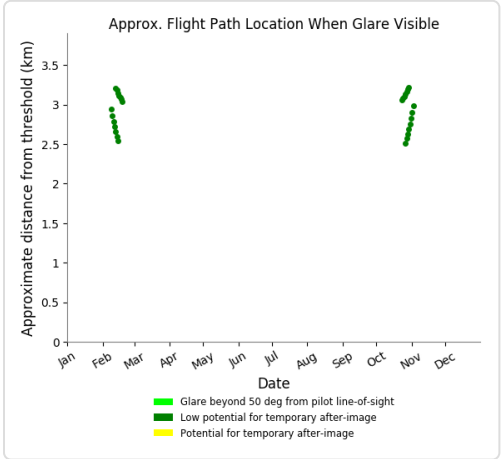
0 minutes of green glare

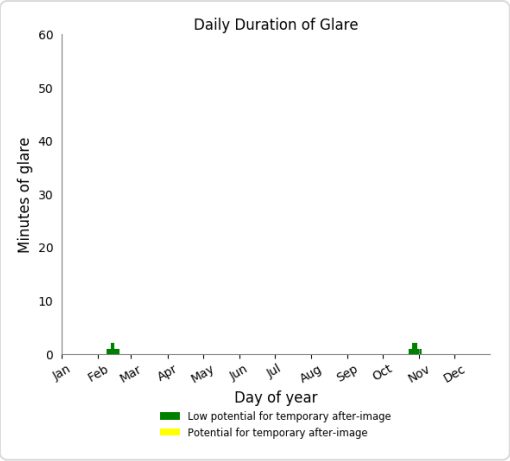
Flight Path: Dublin 34 Runway

0 minutes of yellow glare

29 minutes of green glare







Flight Path: Weston 07 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 25 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 3-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 4-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: Panel Area 2

Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 05 Runway	0	0
Baldonnel 10L Runway	48	0
Baldonnel 10 Runway	44	0
Baldonnel 11 Runway	0	0
Dublin 16 Runway	300	0
Dublin 23 Runway	0	0
Dublin 28R Runway	298	0
Dublin 28 Runway	276	0
Dublin 29 Runway	0	0
Dublin 34 Runway	67	0
Weston 07 Runway	0	0
Weston 25 Runway	0	0
1-ATCT	0	0
2-ATCT	0	0
3-ATCT	0	0
4-ATCT	0	0

Flight Path: Baldonnel 05 Runway

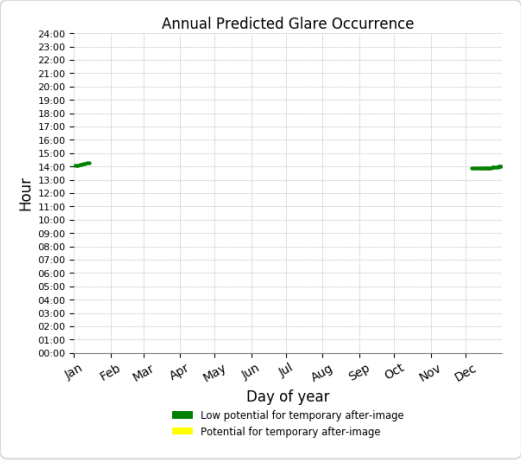
0 minutes of yellow glare

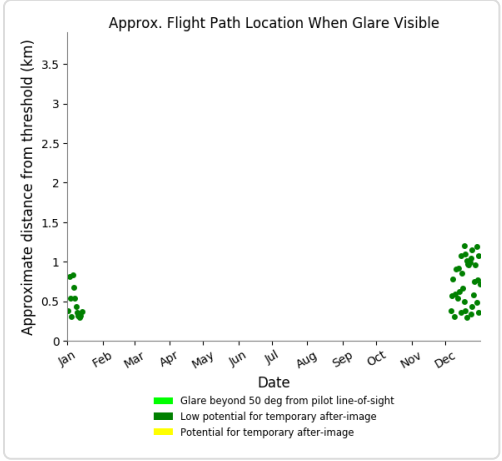
0 minutes of green glare

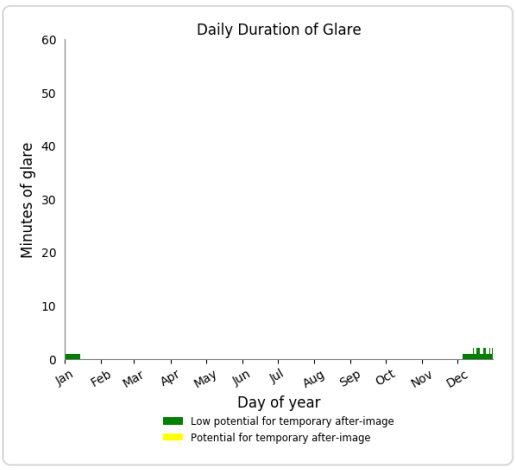
Flight Path: Baldonnel 10L Runway

0 minutes of yellow glare

48 minutes of green glare



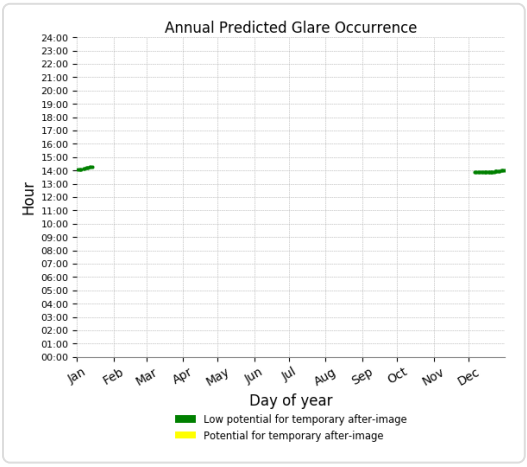


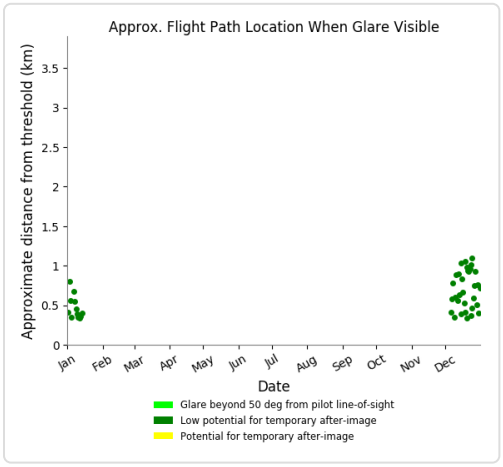


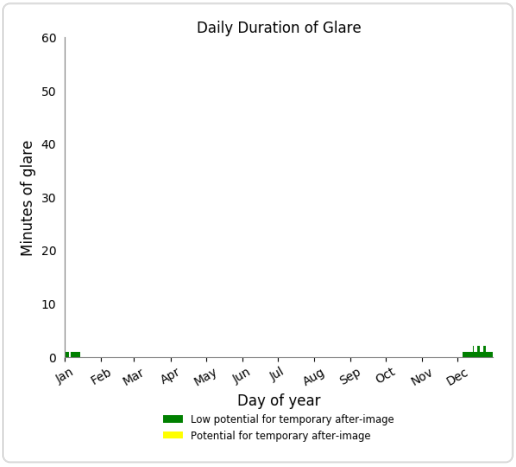
Flight Path: Baldonnel 10 Runway

0 minutes of yellow glare

44 minutes of green glare







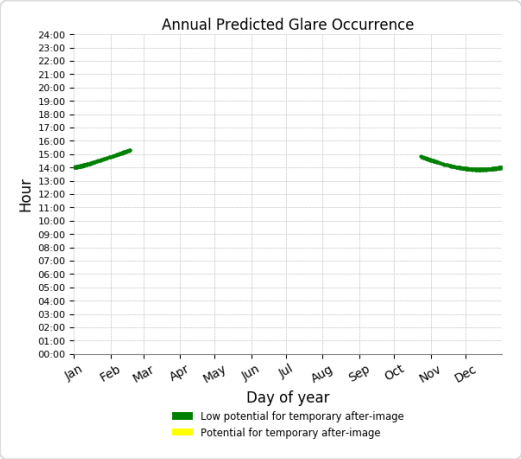
Flight Path: Baldonnel 11 Runway

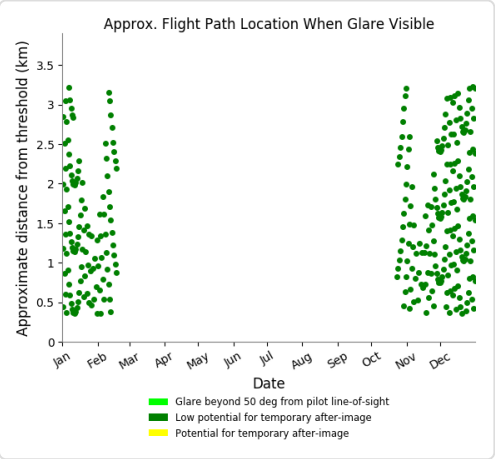
0 minutes of yellow glare

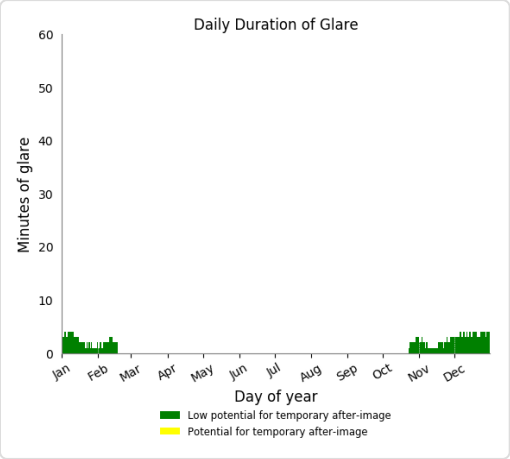
0 minutes of green glare

Flight Path: Dublin 16 Runway

0 minutes of yellow glare
300 minutes of green glare





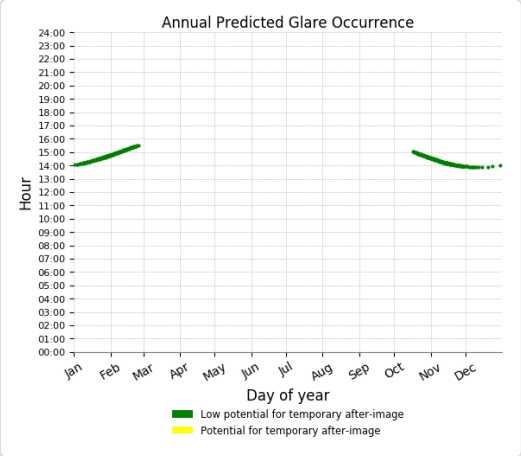


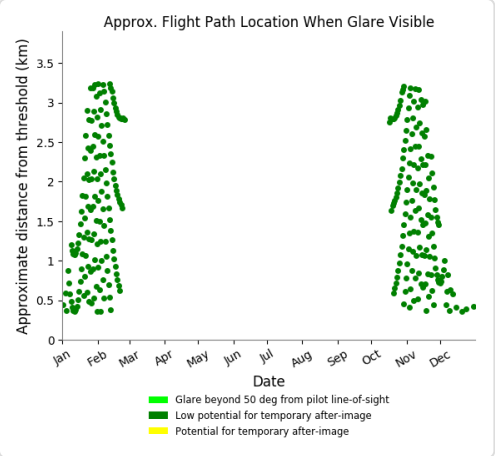
Flight Path: Dublin 23 Runway

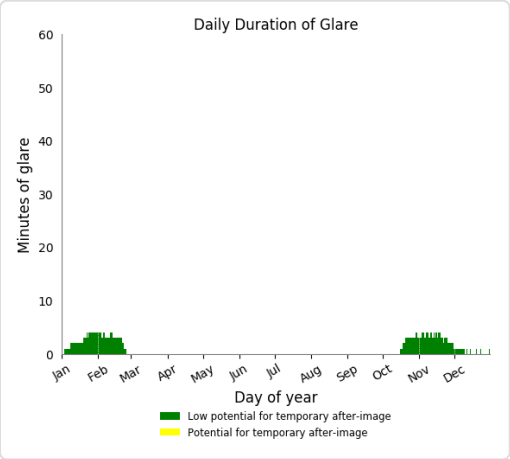
0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28R Runway

0 minutes of yellow glare
298 minutes of green glare



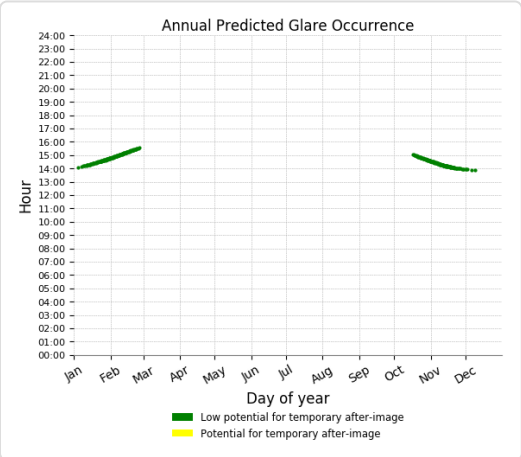


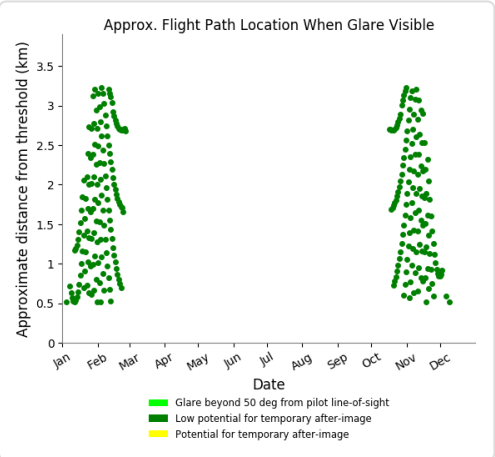


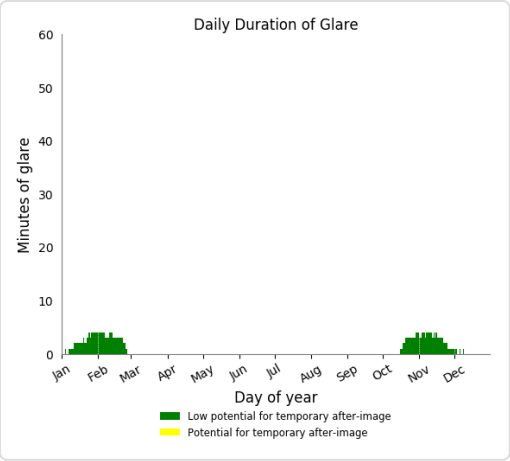
Flight Path: Dublin 28 Runway

0 minutes of yellow glare

276 minutes of green glare







Flight Path: Dublin 29 Runway

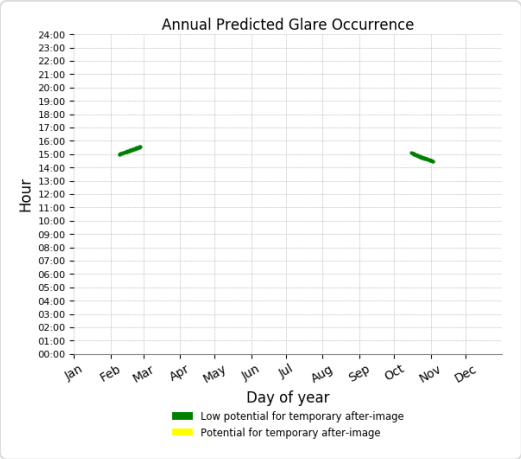
0 minutes of yellow glare

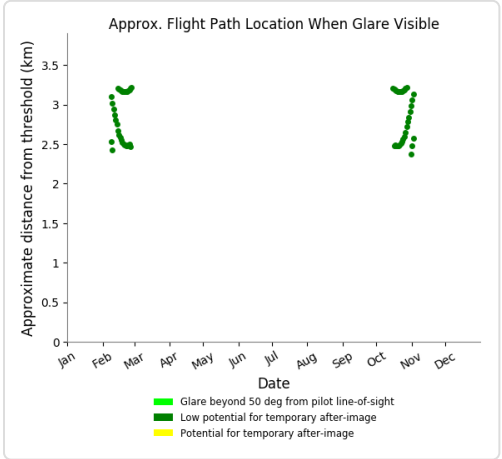
0 minutes of green glare

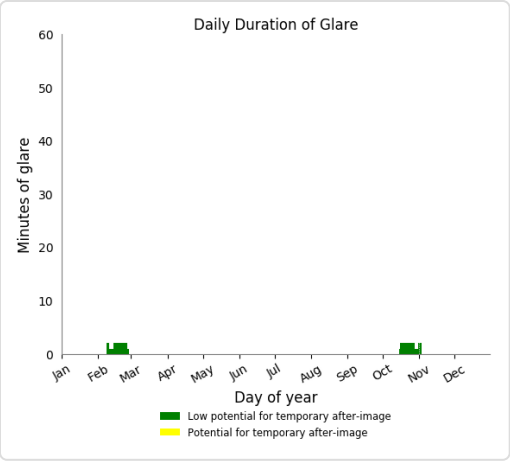
Flight Path: Dublin 34 Runway

0 minutes of yellow glare

67 minutes of green glare







Flight Path: Weston 07 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 25 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 3-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 4-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: Panel Area 3

Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 05 Runway	0	0
Baldonnel 10L Runway	5	0
Baldonnel 10 Runway	2	0
Baldonnel 11 Runway	0	0
Dublin 16 Runway	116	0
Dublin 23 Runway	0	0
Dublin 28R Runway	221	0
Dublin 28 Runway	214	0
Dublin 29 Runway	0	0
Dublin 34 Runway	46	0
Weston 07 Runway	0	0
Weston 25 Runway	0	0
1-ATCT	0	0
2-ATCT	0	0
3-ATCT	0	0
4-ATCT	0	0

Flight Path: Baldonnel 05 Runway

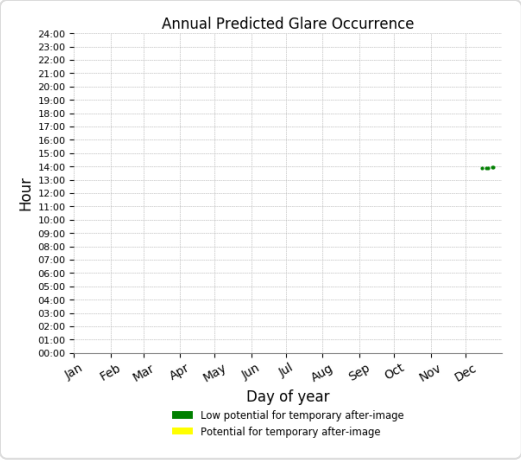
0 minutes of yellow glare

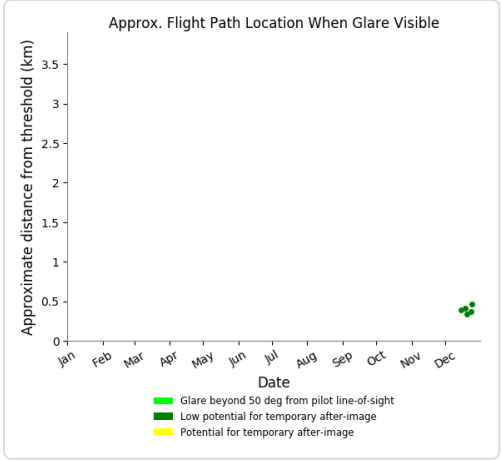
0 minutes of green glare

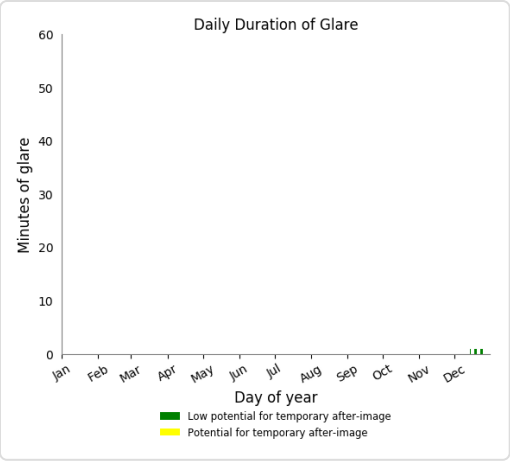
Flight Path: Baldonnel 10L Runway

0 minutes of yellow glare

5 minutes of green glare



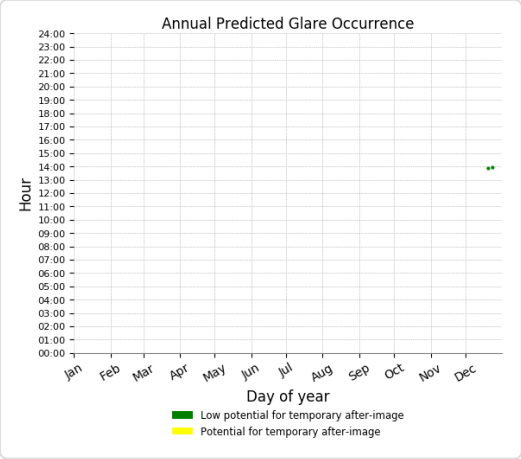


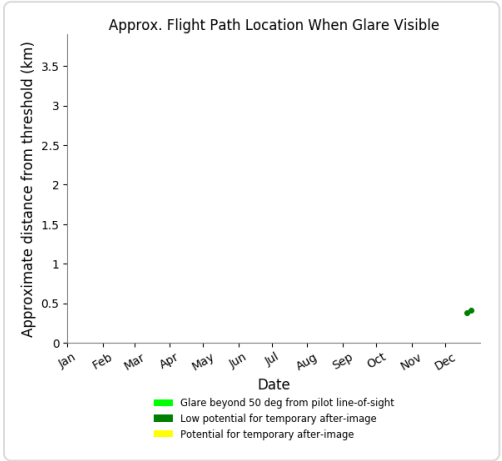


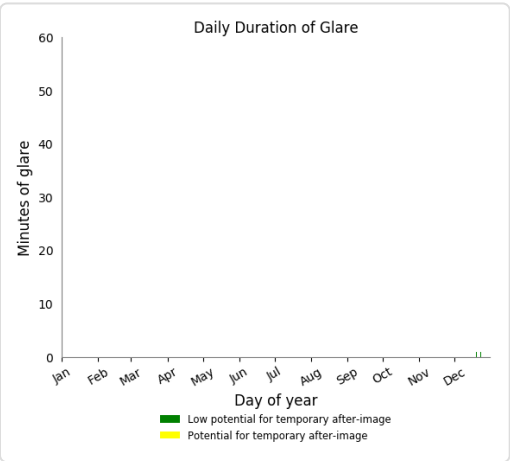
Flight Path: Baldonnel 10 Runway

0 minutes of yellow glare

2 minutes of green glare







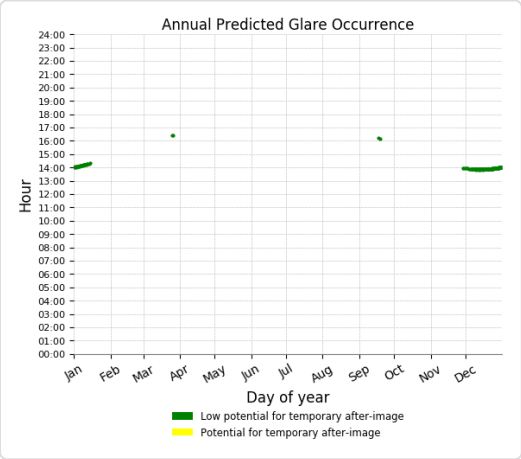
Flight Path: Baldonnel 11 Runway

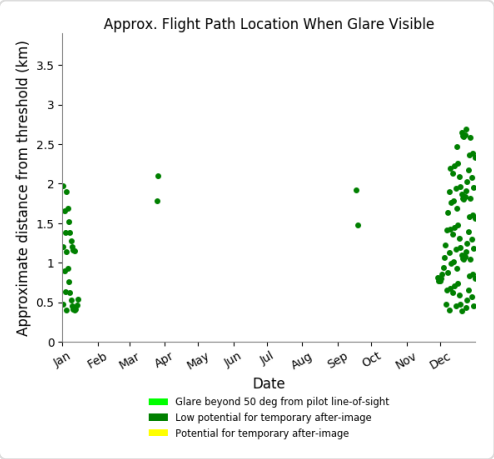
0 minutes of yellow glare

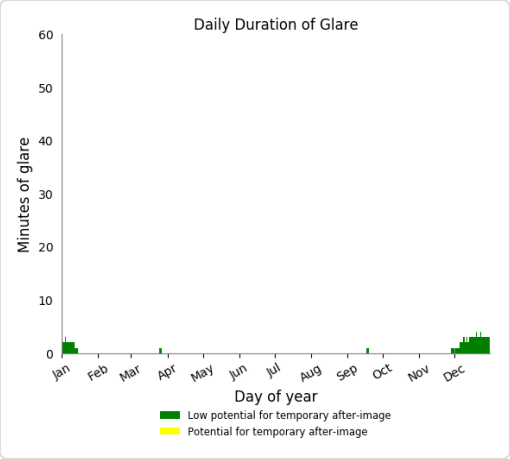
0 minutes of green glare

Flight Path: Dublin 16 Runway

0 minutes of yellow glare
116 minutes of green glare





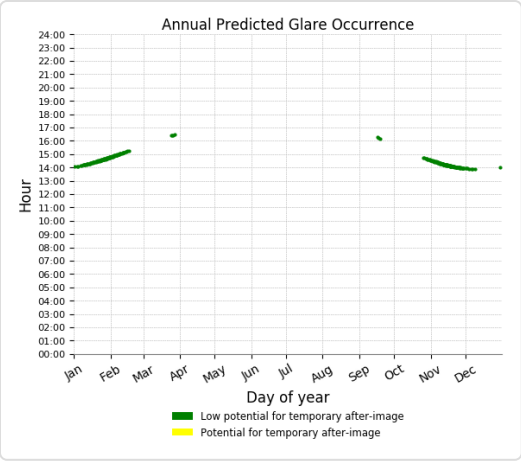


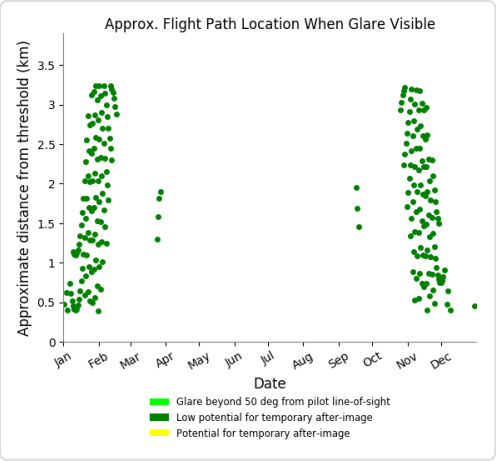
Flight Path: Dublin 23 Runway

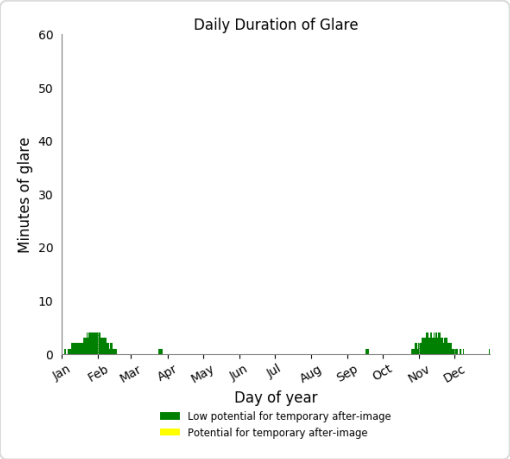
0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28R Runway

0 minutes of yellow glare
221 minutes of green glare



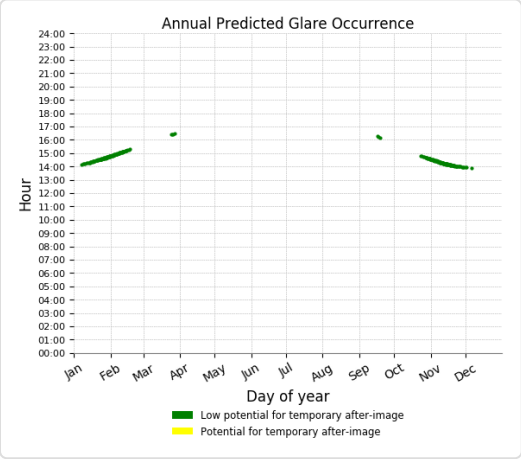


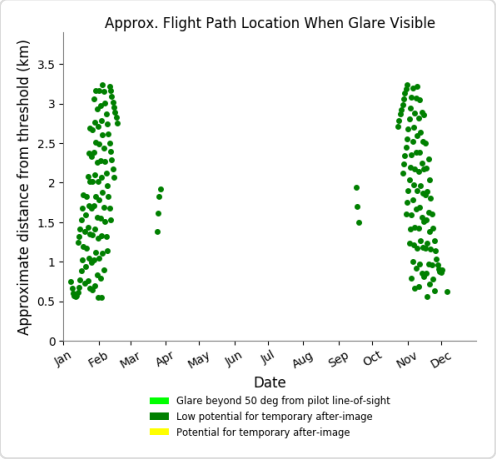


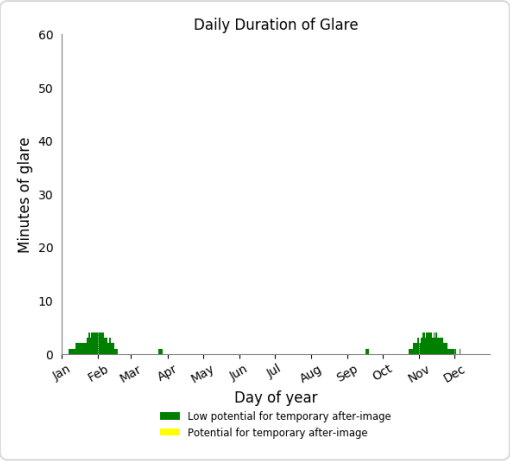
Flight Path: Dublin 28 Runway

0 minutes of yellow glare

214 minutes of green glare







Flight Path: Dublin 29 Runway

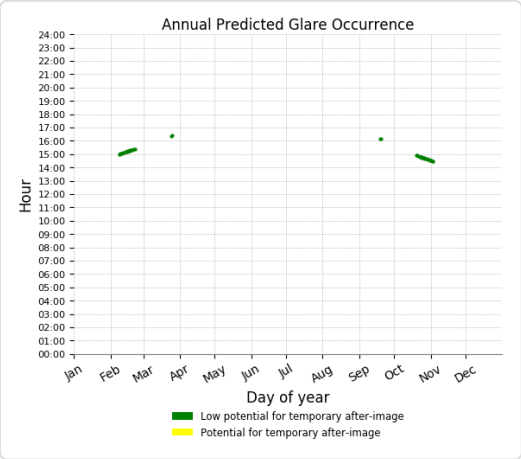
0 minutes of yellow glare

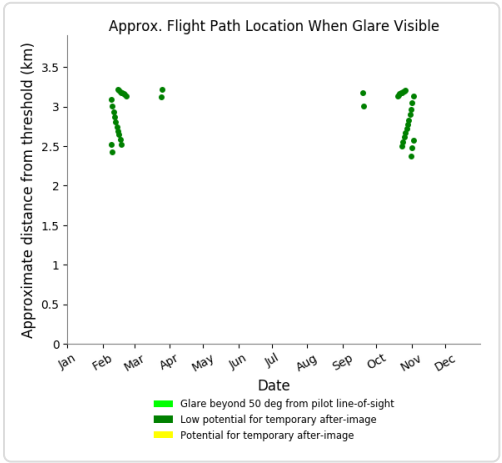
0 minutes of green glare

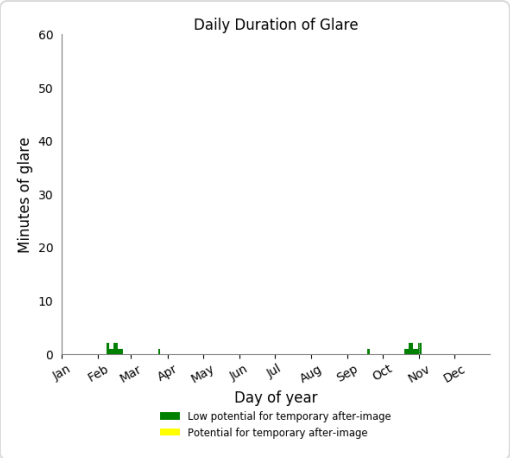
Flight Path: Dublin 34 Runway

0 minutes of yellow glare

46 minutes of green glare







Flight Path: Weston 07 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 25 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 3-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 4-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: Panel Area 4

Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 05 Runway	0	0
Baldonnel 10L Runway	2	0
Baldonnel 10 Runway	0	0
Baldonnel 11 Runway	0	0
Dublin 16 Runway	100	0
Dublin 23 Runway	0	0
Dublin 28R Runway	157	0
Dublin 28 Runway	154	0
Dublin 29 Runway	0	0
Dublin 34 Runway	34	0
Weston 07 Runway	0	0
Weston 25 Runway	0	0
1-ATCT	0	0
2-ATCT	0	0
3-ATCT	0	0
4-ATCT	0	0

Flight Path: Baldonnel 05 Runway

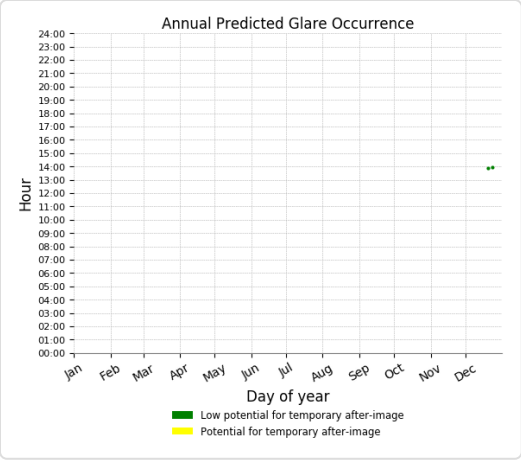
0 minutes of yellow glare

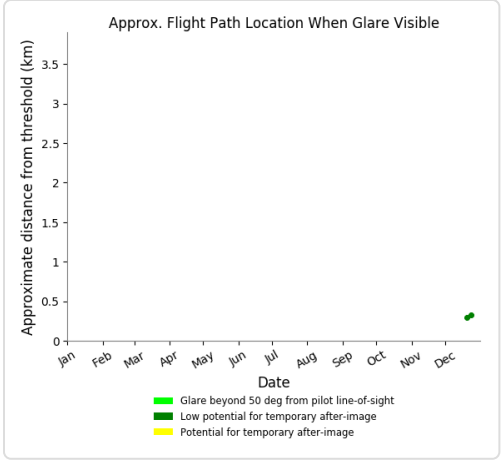
0 minutes of green glare

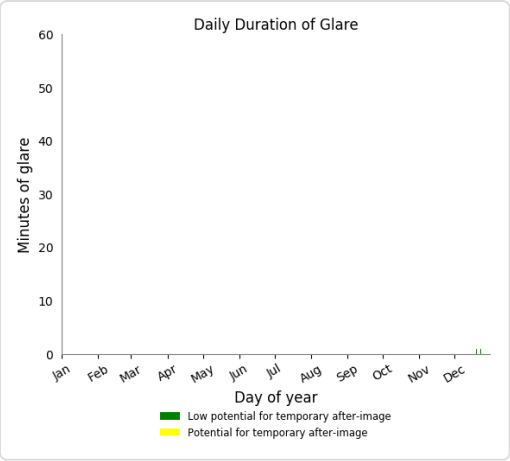
Flight Path: Baldonnel 10L Runway

0 minutes of yellow glare

2 minutes of green glare







Flight Path: Baldonnel 10 Runway

0 minutes of yellow glare

0 minutes of green glare

Flight Path: Baldonnel 11 Runway

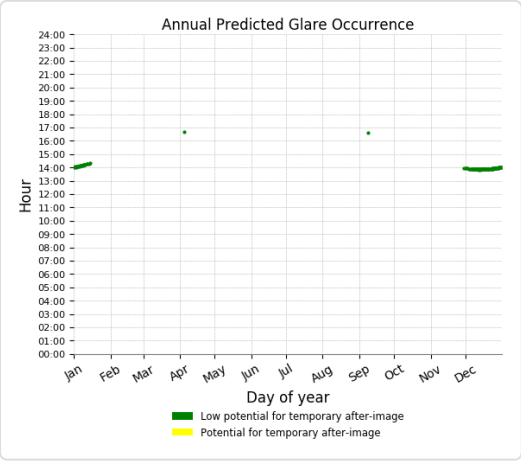
0 minutes of yellow glare

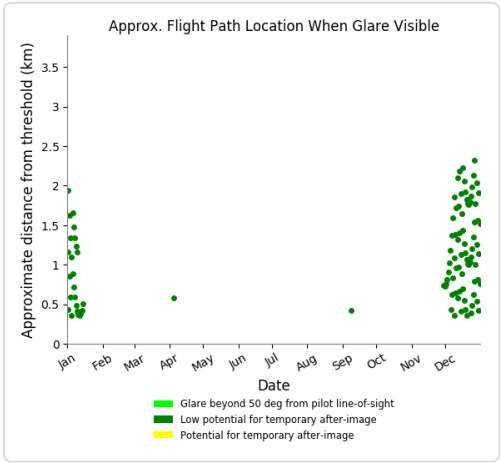
0 minutes of green glare

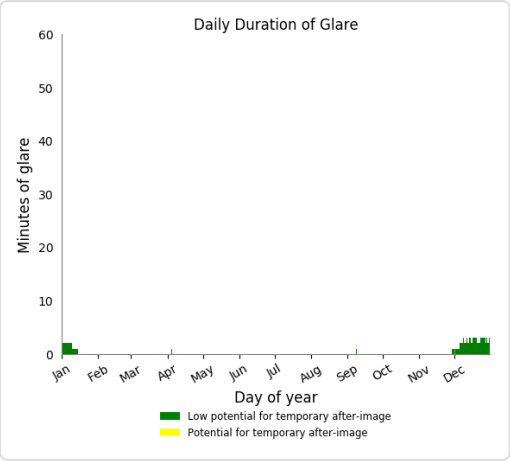
Flight Path: Dublin 16 Runway

0 minutes of yellow glare

100 minutes of green glare







Flight Path: Dublin 23 Runway

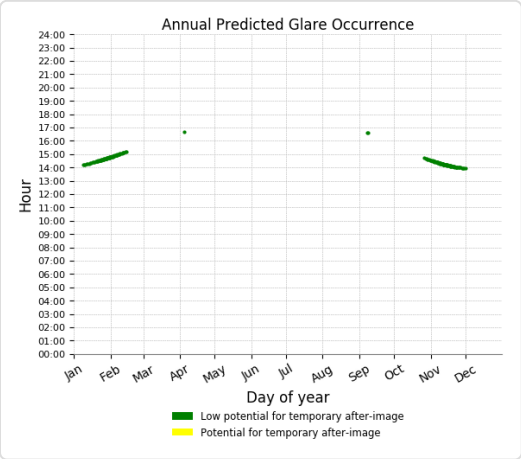
0 minutes of yellow glare

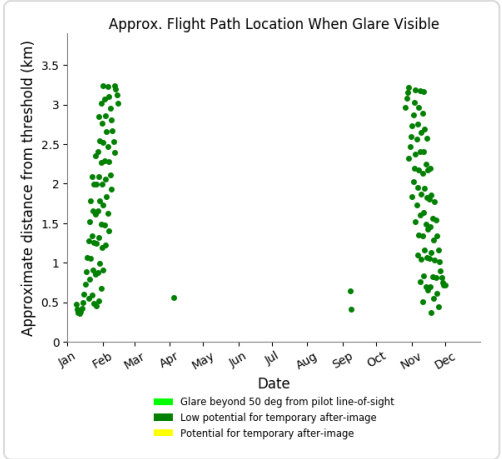
0 minutes of green glare

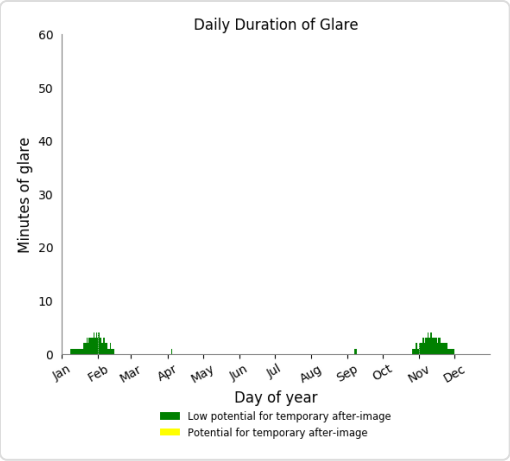
Flight Path: Dublin 28R Runway

0 minutes of yellow glare

157 minutes of green glare



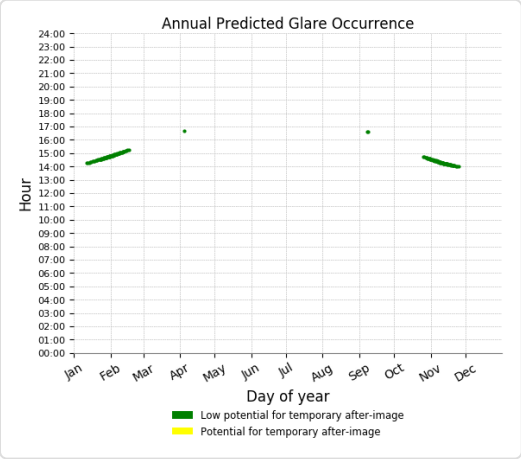


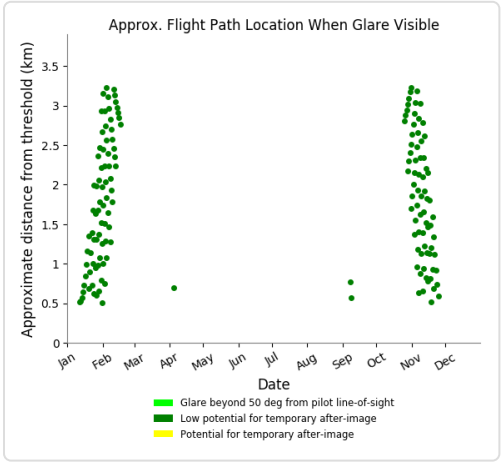


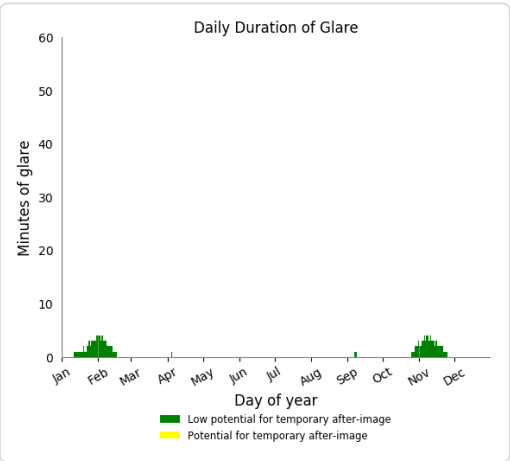
Flight Path: Dublin 28 Runway

0 minutes of yellow glare

154 minutes of green glare







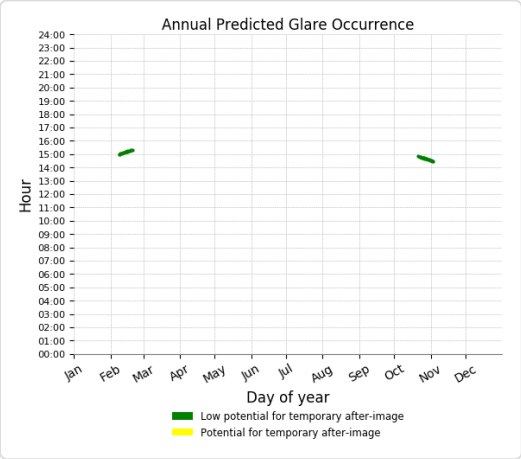
Flight Path: Dublin 29 Runway

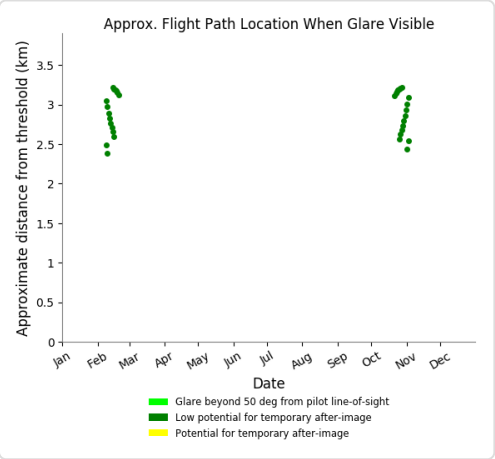
0 minutes of yellow glare

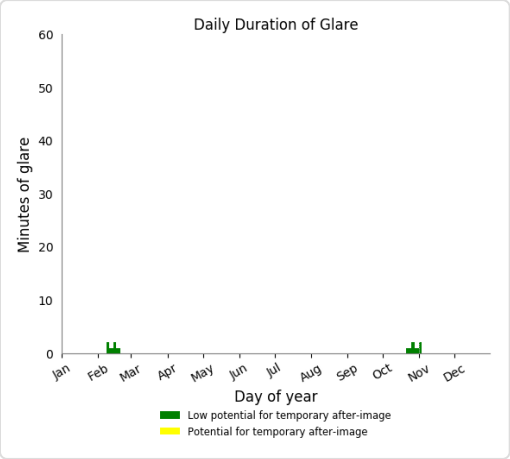
0 minutes of green glare

Flight Path: Dublin 34 Runway

0 minutes of yellow glare
34 minutes of green glare







Flight Path: Weston 07 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 25 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 3-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 4-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: Panel Area 5

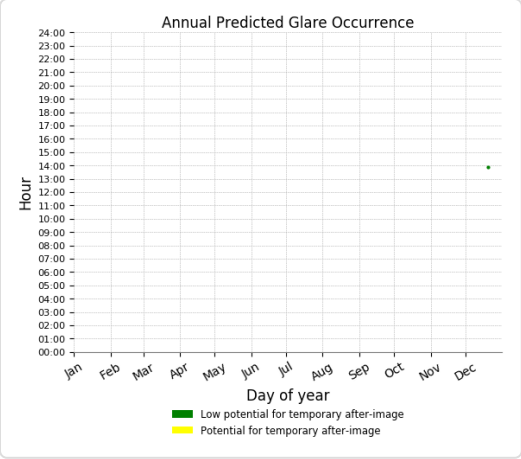
Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 05 Runway	0	0
Baldonnel 10L Runway	1	0
Baldonnel 10 Runway	0	0
Baldonnel 11 Runway	0	0
Dublin 16 Runway	91	0
Dublin 23 Runway	0	0
Dublin 28R Runway	133	0
Dublin 28 Runway	127	0
Dublin 29 Runway	0	0
Dublin 34 Runway	31	0
Weston 07 Runway	0	0
Weston 25 Runway	0	0
1-ATCT	0	0
2-ATCT	0	0
3-ATCT	0	0
4-ATCT	0	0

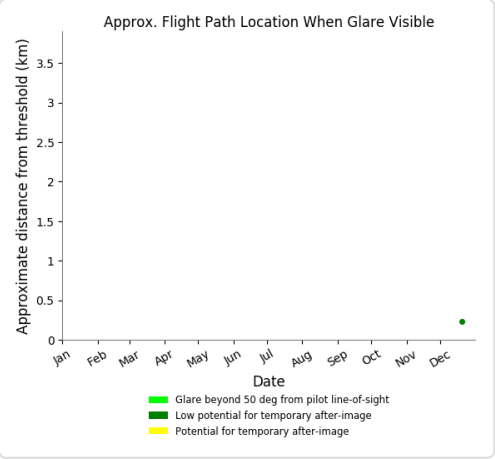
Flight Path: Baldonnel 05 Runway

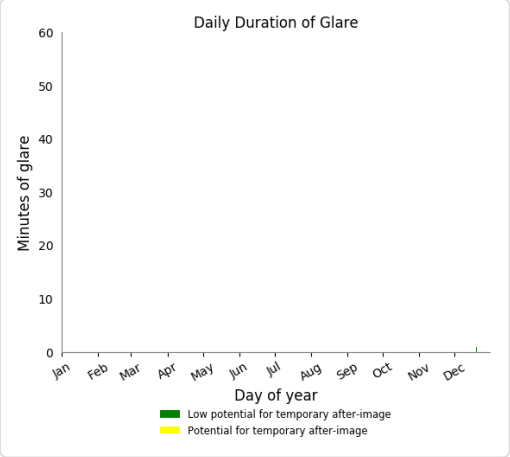
0 minutes of yellow glare
0 minutes of green glare

Flight Path: Baldonnel 10L Runway

0 minutes of yellow glare
1 minutes of green glare







Flight Path: Baldonnel 10 Runway

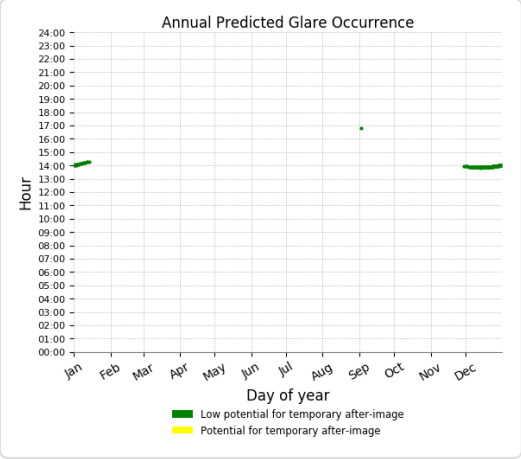
0 minutes of yellow glare
0 minutes of green glare

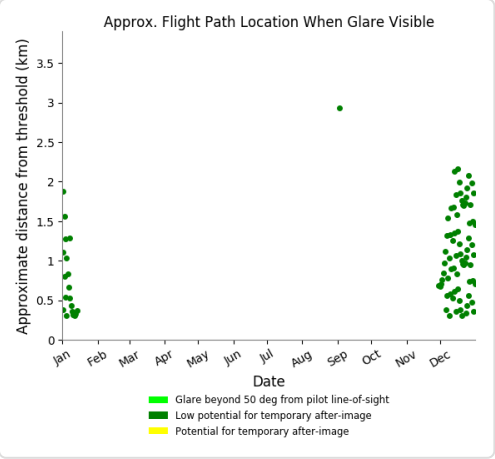
Flight Path: Baldonnel 11 Runway

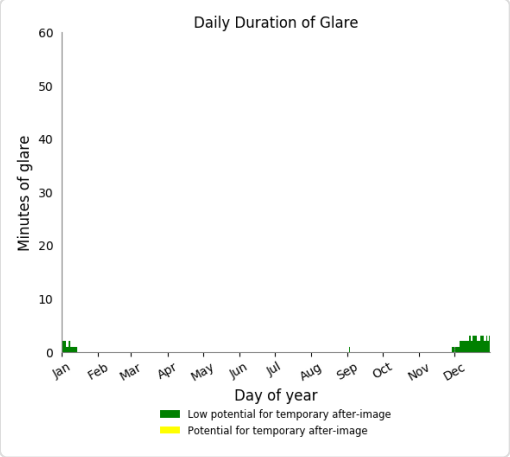
0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 16 Runway

0 minutes of yellow glare
91 minutes of green glare





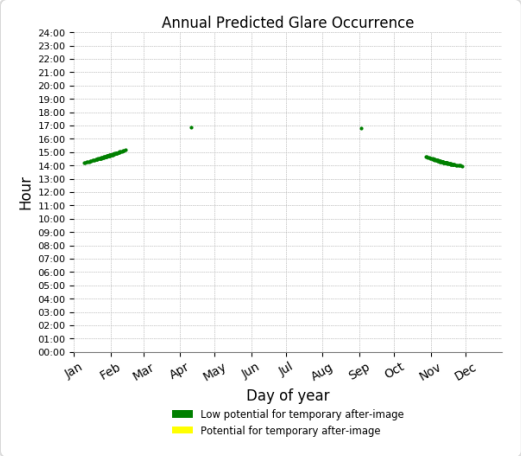


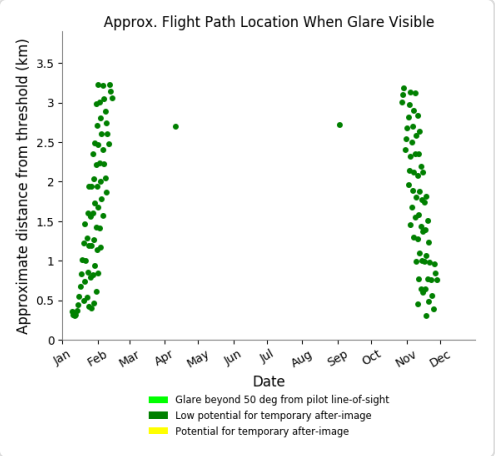
Flight Path: Dublin 23 Runway

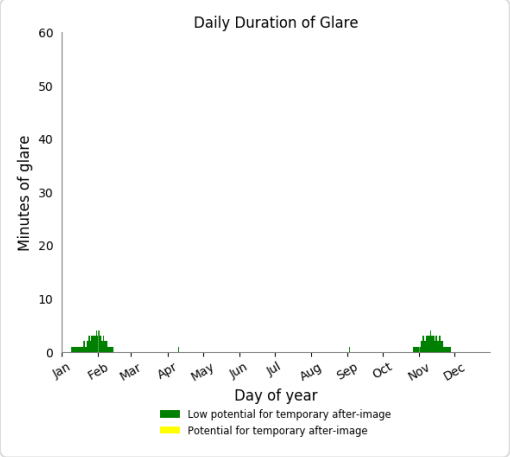
0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28R Runway

0 minutes of yellow glare
133 minutes of green glare



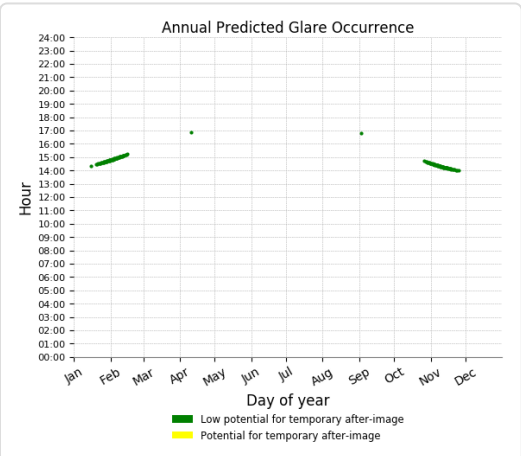


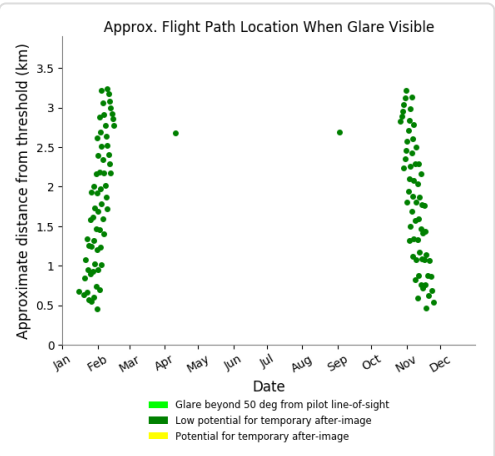


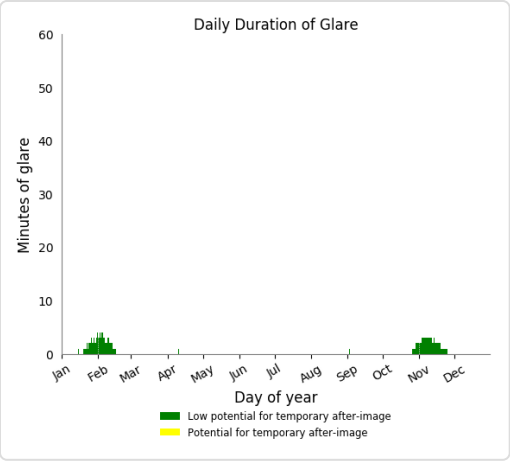
Flight Path: Dublin 28 Runway

0 minutes of yellow glare

127 minutes of green glare







Flight Path: Dublin 29 Runway

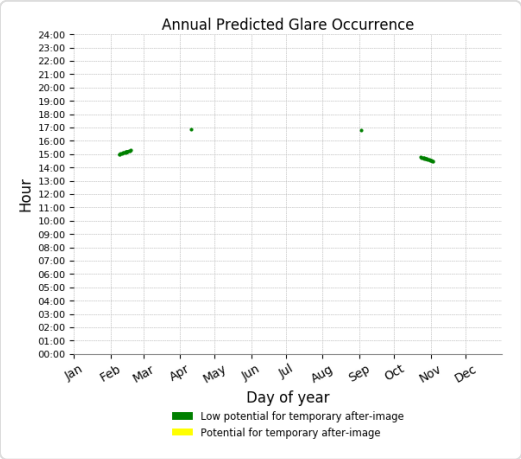
0 minutes of yellow glare

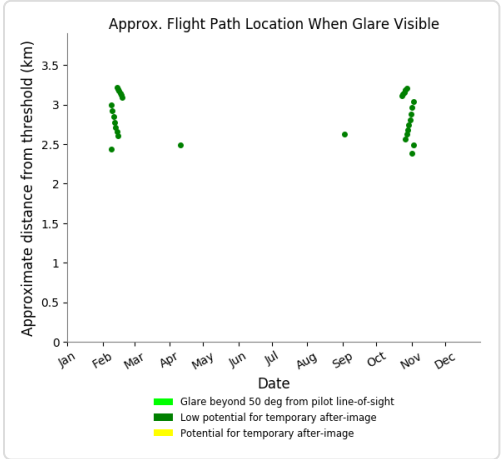
0 minutes of green glare

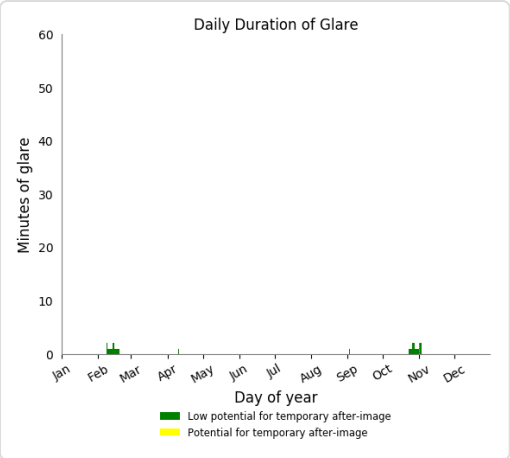
Flight Path: Dublin 34 Runway

0 minutes of yellow glare

31 minutes of green glare







Flight Path: Weston 07 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 25 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 3-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 4-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: Panel Area 6

Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 05 Runway	0	0
Baldonnel 10L Runway	5	0
Baldonnel 10 Runway	3	0
Baldonnel 11 Runway	0	0
Dublin 16 Runway	112	0
Dublin 23 Runway	0	0
Dublin 28R Runway	104	0
Dublin 28 Runway	97	0
Dublin 29 Runway	0	0
Dublin 34 Runway	27	0
Weston 07 Runway	0	0
Weston 25 Runway	0	0
1-ATCT	0	0
2-ATCT	0	0
3-ATCT	0	0
4-ATCT	0	0

Flight Path: Baldonnel 05 Runway

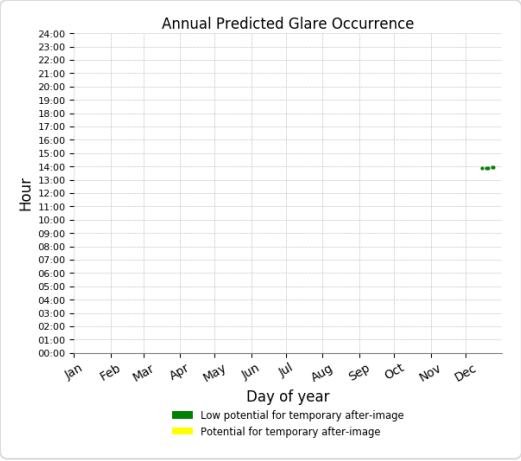
0 minutes of yellow glare

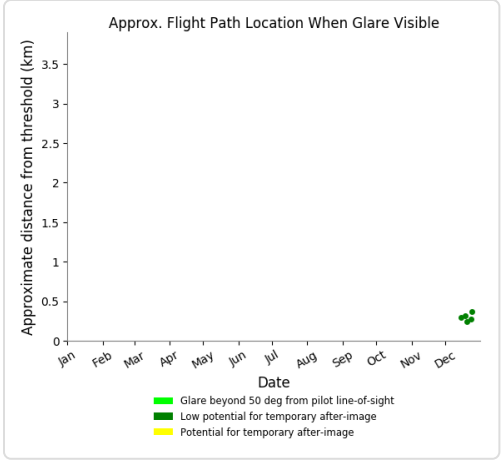
0 minutes of green glare

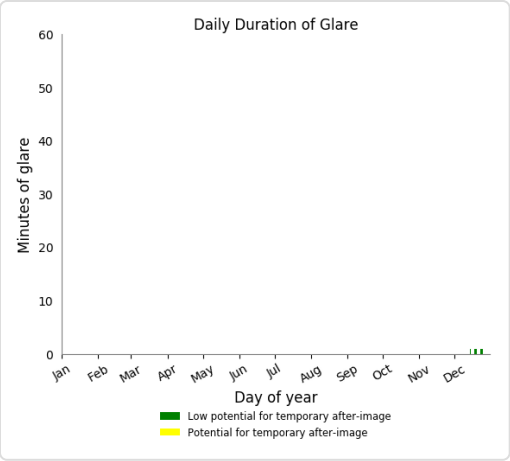
Flight Path: Baldonnel 10L Runway

0 minutes of yellow glare

5 minutes of green glare



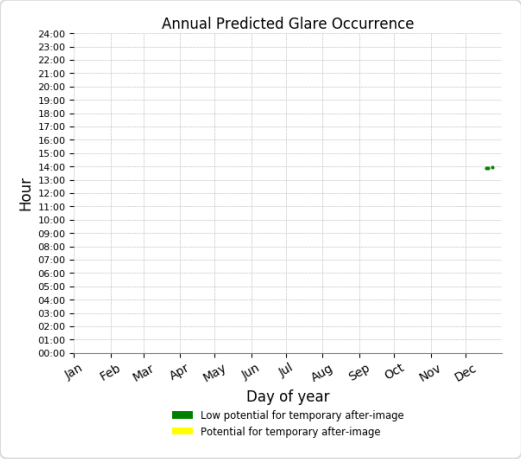


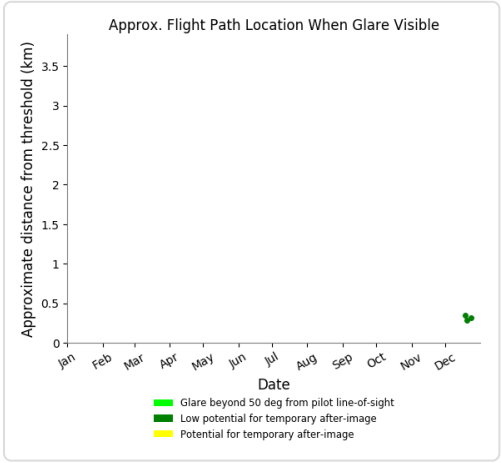


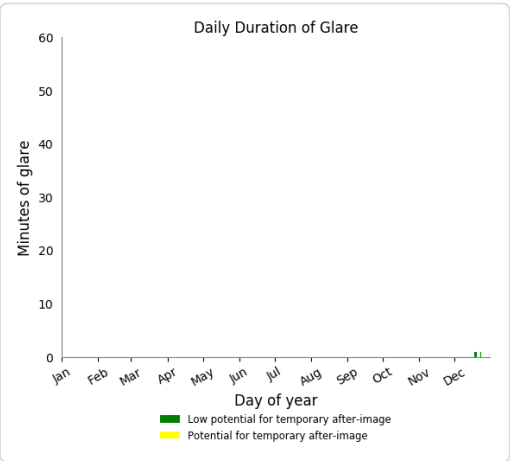
Flight Path: Baldonnel 10 Runway

0 minutes of yellow glare

3 minutes of green glare







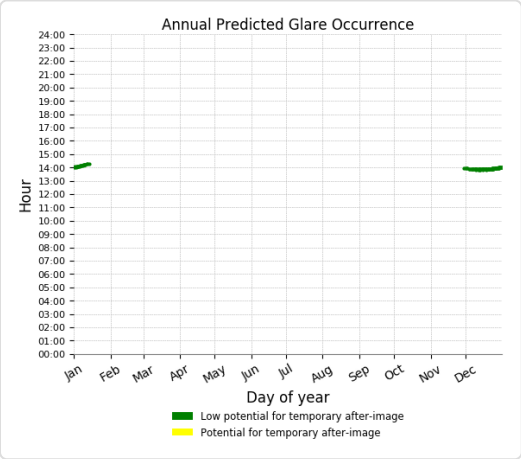
Flight Path: Baldonnel 11 Runway

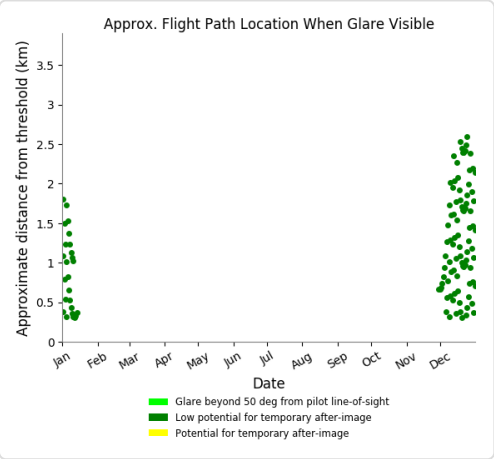
0 minutes of yellow glare

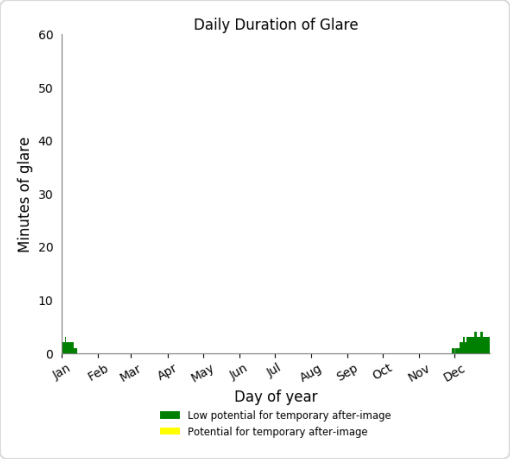
0 minutes of green glare

Flight Path: Dublin 16 Runway

0 minutes of yellow glare
112 minutes of green glare





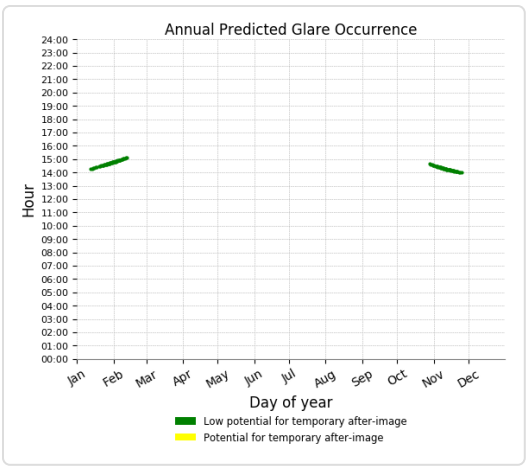


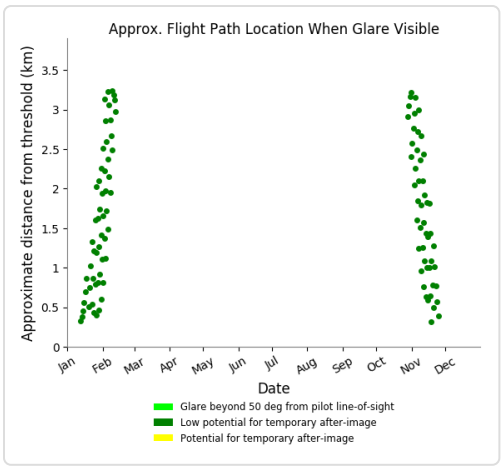
Flight Path: Dublin 23 Runway

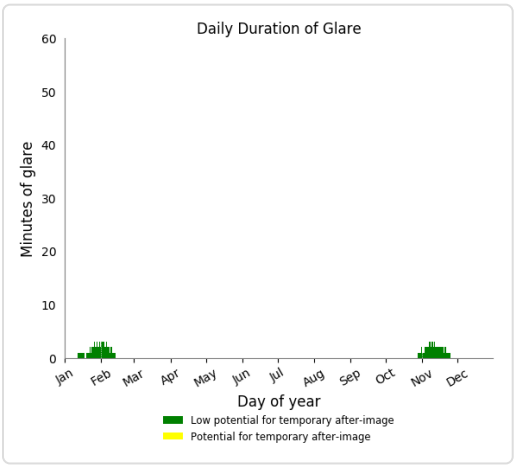
0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28R Runway

0 minutes of yellow glare
104 minutes of green glare



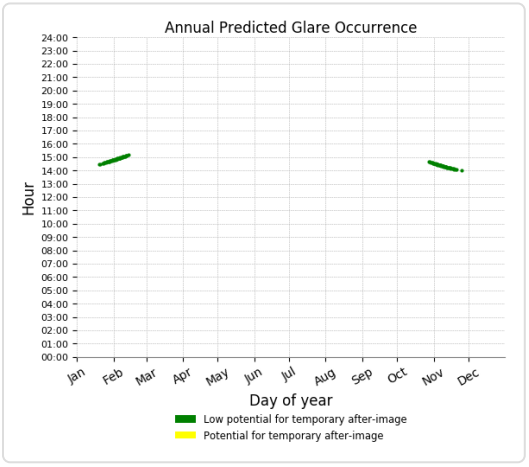


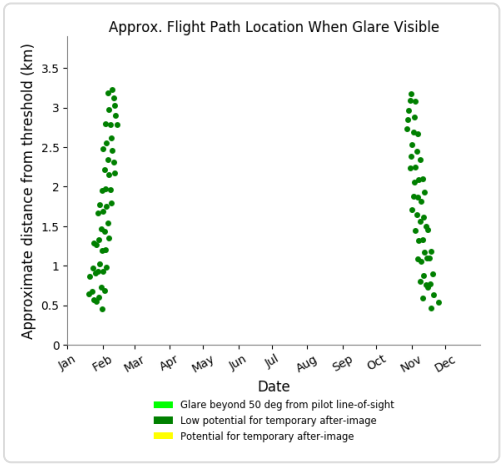


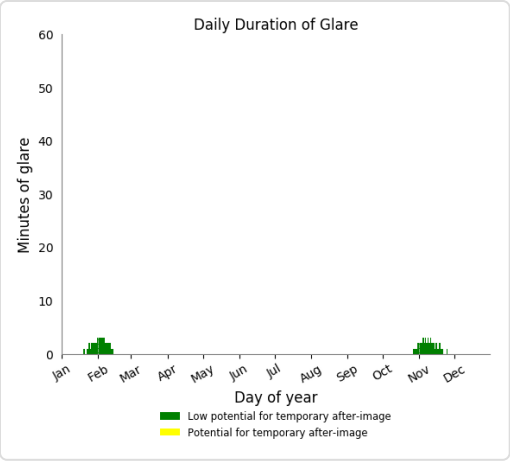
Flight Path: Dublin 28 Runway

0 minutes of yellow glare

97 minutes of green glare







Flight Path: Dublin 29 Runway

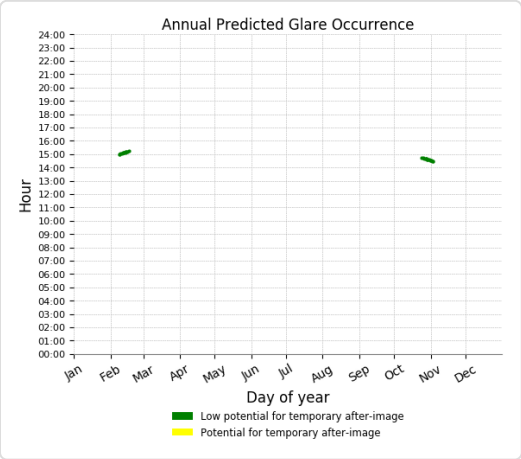
0 minutes of yellow glare

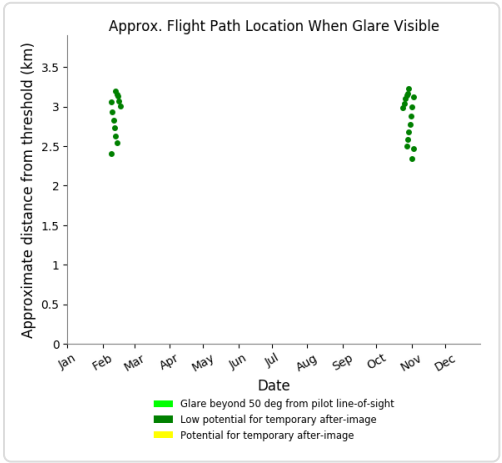
0 minutes of green glare

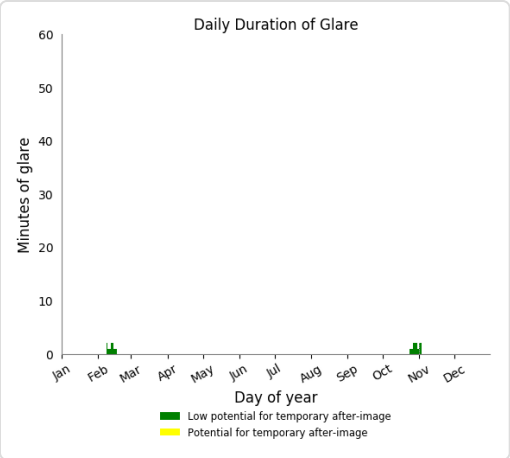
Flight Path: Dublin 34 Runway

0 minutes of yellow glare

27 minutes of green glare







Flight Path: Weston 07 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 25 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 3-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 4-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: Panel Area 7

Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 05 Runway	0	0
Baldonnel 10L Runway	0	0
Baldonnel 10 Runway	0	0
Baldonnel 11 Runway	0	0
Dublin 16 Runway	55	0
Dublin 23 Runway	0	0
Dublin 28R Runway	394	0
Dublin 28 Runway	409	0
Dublin 29 Runway	0	0
Dublin 34 Runway	21	0
Weston 07 Runway	0	0
Weston 25 Runway	0	0
1-ATCT	0	0
2-ATCT	0	0
3-ATCT	0	0
4-ATCT	0	0

Flight Path: Baldonnel 05 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Baldonnel 10L Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Baldonnel 10 Runway

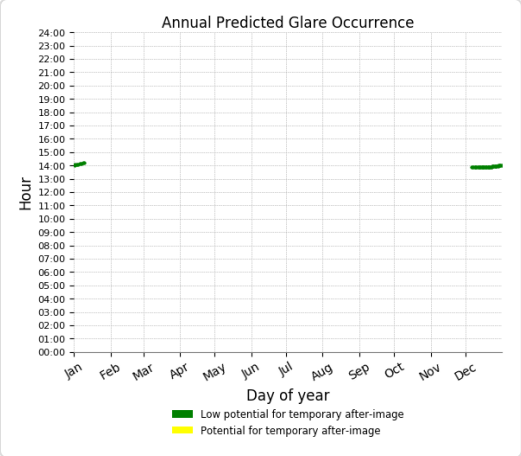
0 minutes of yellow glare
0 minutes of green glare

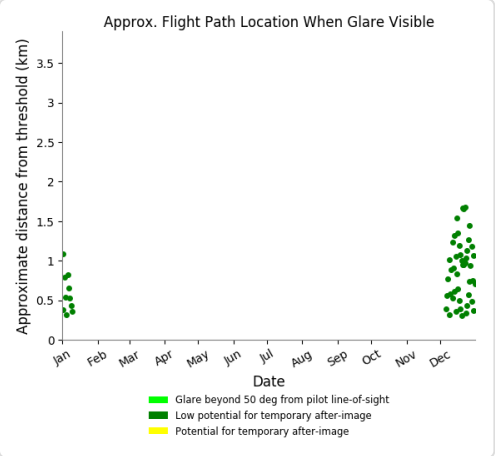
Flight Path: Baldonnel 11 Runway

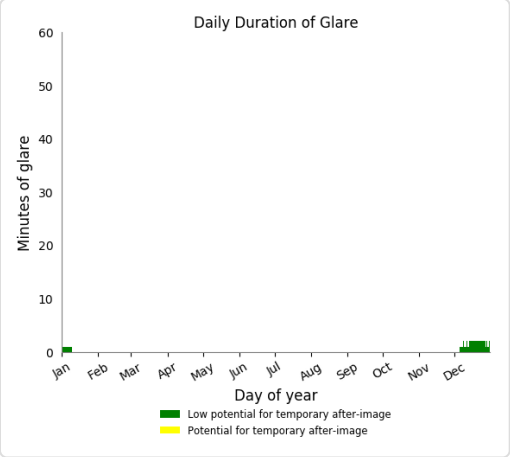
0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 16 Runway

0 minutes of yellow glare
55 minutes of green glare





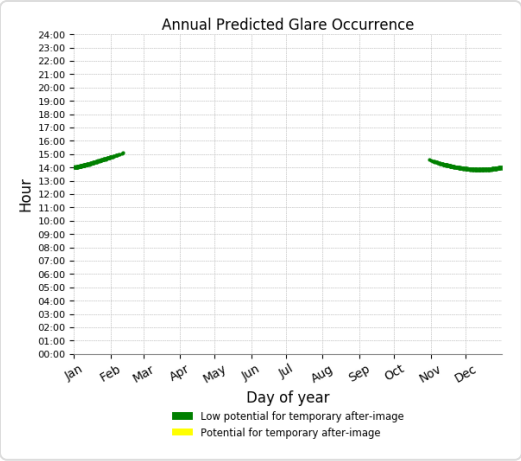


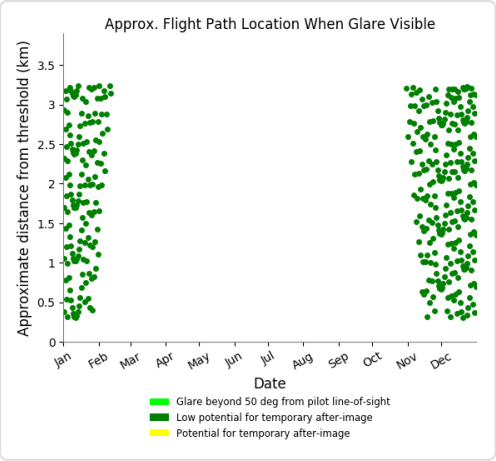
Flight Path: Dublin 23 Runway

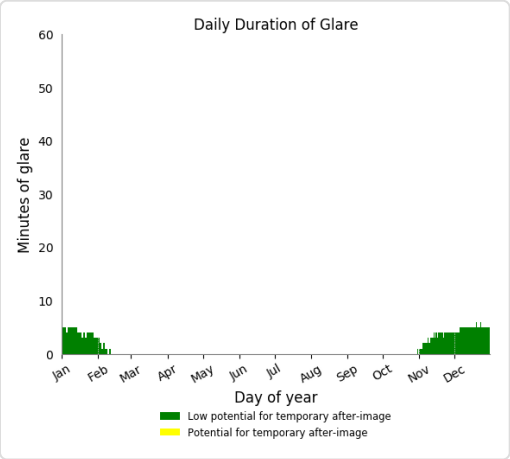
0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28R Runway

0 minutes of yellow glare
394 minutes of green glare



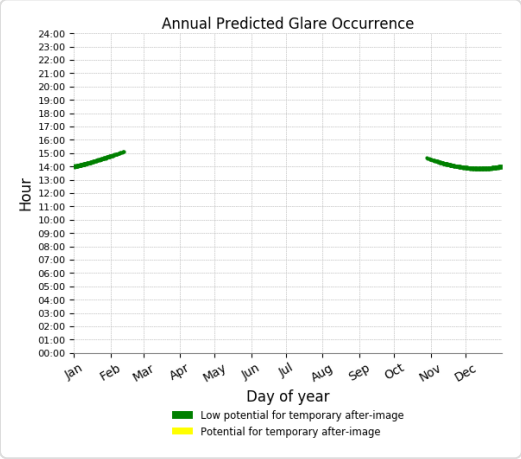


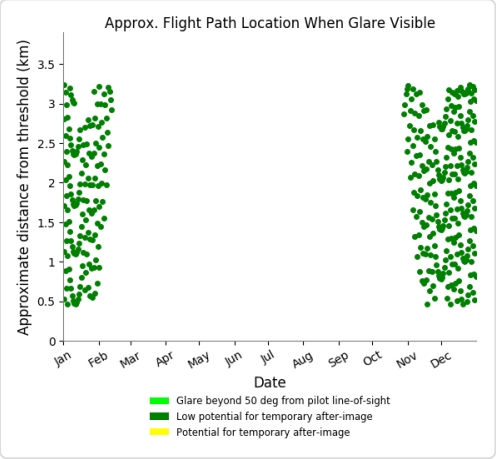


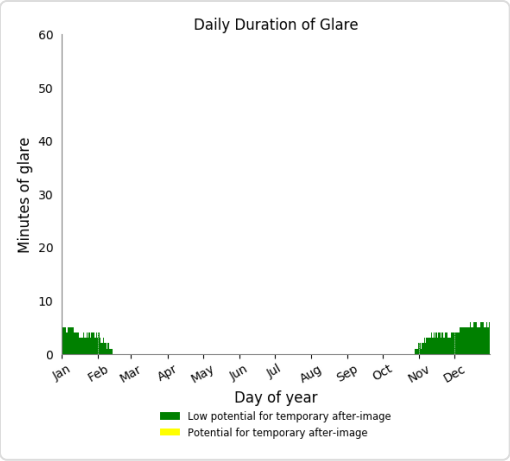
Flight Path: Dublin 28 Runway

0 minutes of yellow glare

409 minutes of green glare







Flight Path: Dublin 29 Runway

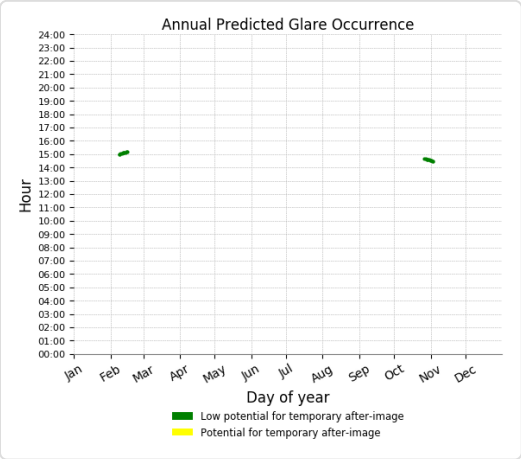
0 minutes of yellow glare

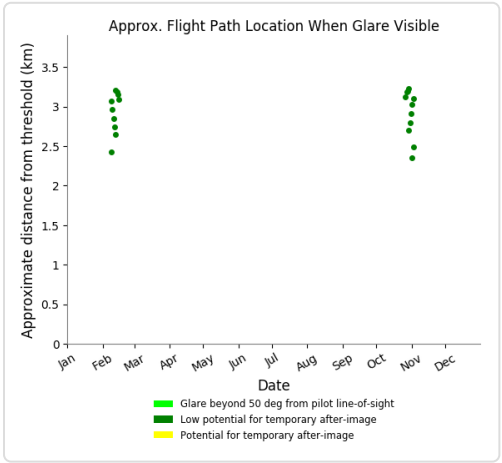
0 minutes of green glare

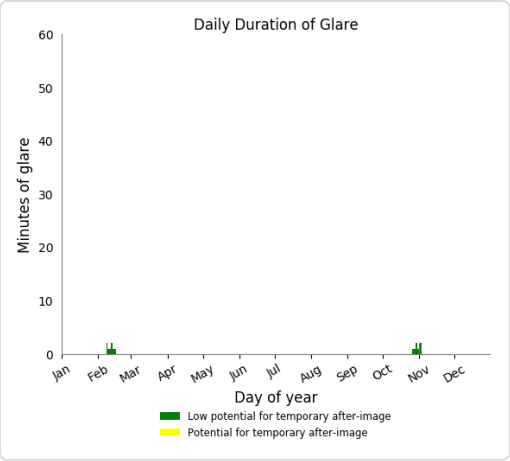
Flight Path: Dublin 34 Runway

0 minutes of yellow glare

21 minutes of green glare







Flight Path: Weston 07 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 25 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 3-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 4-ATCT

0 minutes of yellow glare
0 minutes of green glare

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values may differ.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.

APPENDIX B:

SGHAT RESULTS – STANDARD AVIATION RECEPTORS (WEST FACING PV PANELS)

Note:

The SGHAT Air Traffic Control Tower references are as follows:

1-ATCT: Existing tower at Baldonnel Aerodrome

2-ATCT: New tower under construction at Dublin Airport

3-ATCT: Existing tower at Dublin Airport

4-ATCT: Existing tower at Weston Airport

FORGESOLAR GLARE ANALYSIS

Project: **Dublin Airport**
Site configuration: **Belgard Gardens 260 Deg**
Analysis conducted by Nikolas Hennessy (nik@macroworks.ie) at 14:46 on 22 Oct, 2018.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	PASS	Flight path receptor(s) do not receive yellow glare
ATCT(s)	PASS	Receptor(s) marked as ATCT do not receive glare

Default glare analysis and observer eye characteristics are as follows:

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

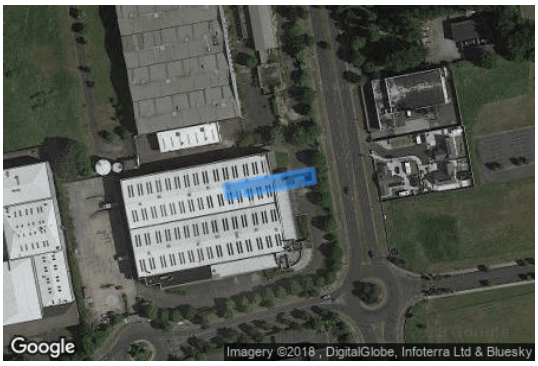
SITE CONFIGURATION

Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 21995.2021

PV Array(s)

Name: Panel Area 1
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 260.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.291307	-6.368810	100.00	19.00	119.00
2	53.291235	-6.368792	99.00	20.00	119.00
3	53.291223	-6.368898	99.00	20.00	119.00
4	53.291257	-6.368908	99.00	20.00	119.00
5	53.291251	-6.368960	99.00	20.00	119.00
6	53.291216	-6.368946	99.00	20.00	119.00
7	53.291164	-6.369432	99.00	20.00	119.00
8	53.291198	-6.369439	99.00	20.00	119.00
9	53.291193	-6.369491	99.00	20.00	119.00
10	53.291159	-6.369480	99.00	20.00	119.00
11	53.291147	-6.369587	99.00	20.00	119.00
12	53.291220	-6.369611	99.00	20.00	119.00
13	53.291307	-6.368810	99.00	20.00	119.00

Name: Panel Area 2
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 260.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.290775	-6.370087	99.00	26.00	125.00
2	53.290669	-6.370053	99.00	26.00	125.00
3	53.290640	-6.370311	99.00	26.00	125.00
4	53.290746	-6.370343	99.00	26.00	125.00
5	53.290762	-6.370204	99.00	26.00	125.00
6	53.290741	-6.370199	99.00	26.00	125.00
7	53.290744	-6.370156	99.00	26.00	125.00
8	53.290765	-6.370162	99.00	26.00	125.00
9	53.290775	-6.370087	99.00	26.00	125.00

Name: Panel Area 3
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 260.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.290898	-6.370123	99.00	28.00	127.00
2	53.290870	-6.370380	99.00	28.00	127.00
3	53.290929	-6.370397	99.00	28.00	127.00
4	53.290957	-6.370141	99.00	28.00	127.00
5	53.290898	-6.370123	99.00	28.00	127.00

Name: Panel Area 4
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 260.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.291080	-6.370180	99.00	26.00	125.00
2	53.291052	-6.370434	99.00	26.00	125.00
3	53.291084	-6.370445	99.00	26.00	125.00
4	53.291112	-6.370191	99.00	26.00	125.00
5	53.291080	-6.370180	99.00	26.00	125.00

Name: Panel Area 5
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 260.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.291117	-6.370191	99.00	23.00	122.00
2	53.291089	-6.370446	99.00	23.00	122.00
3	53.291106	-6.370451	99.00	23.00	122.00
4	53.291135	-6.370196	99.00	23.00	122.00
5	53.291117	-6.370191	99.00	23.00	122.00

Name: Panel Area 6
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 260.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.290961	-6.370870	100.50	21.70	122.20
2	53.290799	-6.370821	100.50	21.70	122.20
3	53.290797	-6.370843	100.50	21.70	122.20
4	53.290643	-6.370796	100.50	21.70	122.20
5	53.290625	-6.370966	100.50	21.70	122.20
6	53.290843	-6.371033	100.50	21.70	122.20
7	53.290852	-6.370959	100.50	21.70	122.20
8	53.290881	-6.370968	100.50	21.70	122.20
9	53.290873	-6.371041	100.50	21.70	122.20
10	53.290939	-6.371062	100.50	21.70	122.20
11	53.290961	-6.370870	100.50	21.70	122.20

Name: Panel Area 7
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 260.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.290815	-6.371603	101.00	21.20	122.20
2	53.290462	-6.371495	101.00	21.20	122.20
3	53.290444	-6.371664	101.00	21.20	122.20
4	53.290701	-6.371743	101.00	21.20	122.20
5	53.290709	-6.371669	101.00	21.20	122.20
6	53.290738	-6.371678	101.00	21.20	122.20
7	53.290730	-6.371751	101.00	21.20	122.20
8	53.290797	-6.371770	101.00	21.20	122.20
9	53.290815	-6.371603	101.00	21.20	122.20

Flight Path Receptor(s)

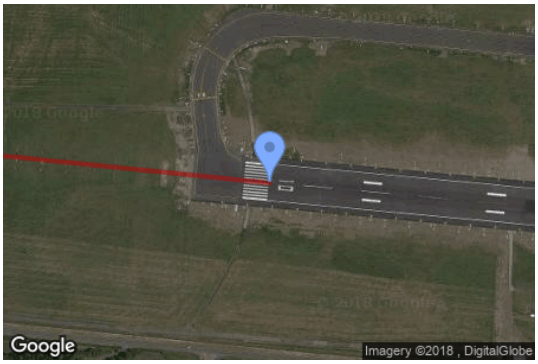
Name: Baldonnel 05 Runway
Description: None
Threshold height: 15 m
Direction: 41.3°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.293830	-6.453465	98.30	15.20	113.50
Two-mile	53.272113	-6.485435	154.40	127.80	282.20

Name: Baldonnel 10L Runway
Description: None
Threshold height: 15 m
Direction: 95.8°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.436880	-6.280253	71.90	15.20	87.10
Two-mile	53.439822	-6.328592	74.90	180.90	255.80

Name: Baldonnel 10 Runway
Description: None
Threshold height: 15 m
Direction: 95.8°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

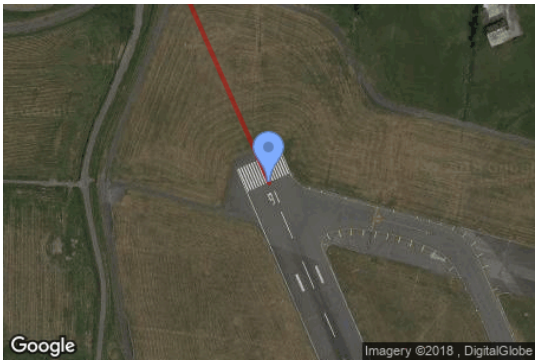


Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.422405	-6.289520	74.00	15.30	89.30
Two-mile	53.425327	-6.337846	80.30	177.60	257.90

Name: Baldonnel 11 Runway
Description: None
Threshold height: 15 m
Direction: 101.8°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.304622	-6.468287	86.32	15.30	101.62
Two-mile	53.310534	-6.515705	73.64	196.60	270.24

Name: Dublin 16 Runway
Description: None
Threshold height: 15 m
Direction: 156.1°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.436699	-6.261764	66.50	15.20	81.70
Two-mile	53.463138	-6.281428	69.70	180.70	250.40

Name: Dublin 23 Runway
Description: None
Threshold height: 15 m
Direction: 220.9°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.303267	-6.439788	93.40	15.20	108.60
Two-mile	53.325107	-6.408047	62.50	214.80	277.30

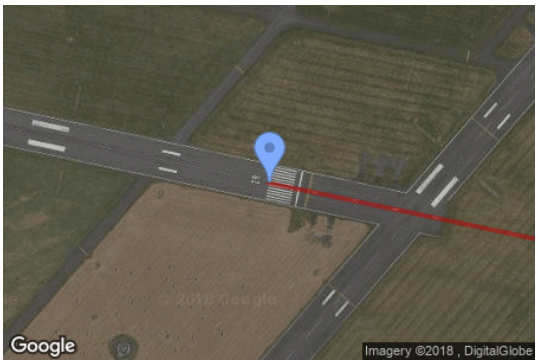
Name: Dublin 28R Runway
Description: None
Threshold height: 15 m
Direction: 275.9°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.435084	-6.240975	65.50	15.30	80.80
Two-mile	53.432097	-6.192645	34.00	215.50	249.50

Name: Dublin 28 Runway
Description: None
Threshold height: 15 m
Direction: 275.5°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

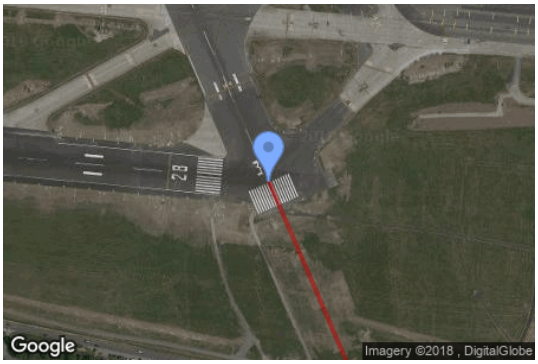
Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.420299	-6.251111	62.00	15.20	77.20
Two-mile	53.417517	-6.202763	41.90	204.00	245.90

Name: Dublin 29 Runway
Description: None
Threshold height: 15 m
Direction: 281.8°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.301696	-6.445153	96.10	15.20	111.30
Two-mile	53.295759	-6.397747	106.20	173.80	280.00

Name: Dublin 34 Runway
Description: None
Threshold height: 15 m
Direction: 336.6°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.420211	-6.249810	62.20	15.30	77.50
Two-mile	53.393680	-6.230504	49.00	197.10	246.10

Name: Weston 07 Runway
Description:
Threshold height: 15 m
Direction: 63.2°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.350769	-6.493327	47.50	15.24	62.74
Two-mile	53.337746	-6.536623	54.61	176.82	231.43

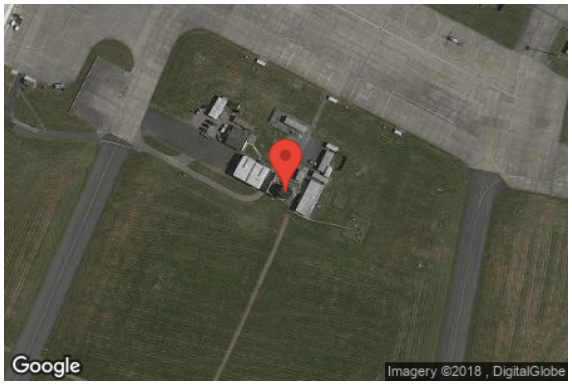
Name: Weston 25 Runway
Description:
Threshold height: 15 m
Direction: 243.3°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.354032	-6.482615	46.75	15.24	61.99
Two-mile	53.367023	-6.439289	30.12	200.55	230.68

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
1-ATCT	1	53.305496	-6.441790	93.50	9.00
2-ATCT	2	53.428489	-6.262201	65.90	21.90
3-ATCT	3	53.428937	-6.264259	65.60	75.60
4-ATCT	4	53.355640	-6.489488	49.45	15.00

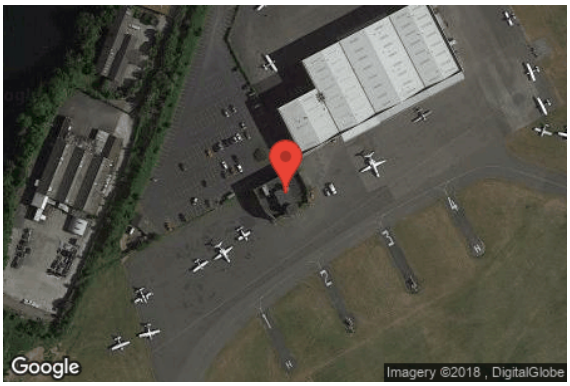
Map image of 1-ATCT



Map image of 2-ATCT

Map image of 3-ATCT

Map image of 4-ATCT



GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Panel Area 1	10.0	260.0	1,188	0	-
Panel Area 2	10.0	260.0	862	0	-
Panel Area 3	10.0	260.0	856	0	-
Panel Area 4	10.0	260.0	1,150	0	-
Panel Area 5	10.0	260.0	1,198	0	-
Panel Area 6	10.0	260.0	367	0	-
Panel Area 7	10.0	260.0	359	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
Baldonnel 05 Runway	3563	0
Baldonnel 10L Runway	0	0
Baldonnel 10 Runway	0	0
Baldonnel 11 Runway	2417	0
Dublin 16 Runway	0	0
Dublin 23 Runway	0	0
Dublin 28R Runway	0	0
Dublin 28 Runway	0	0
Dublin 29 Runway	0	0
Dublin 34 Runway	0	0
Weston 07 Runway	0	0
Weston 25 Runway	0	0
1-ATCT	0	0
2-ATCT	0	0
3-ATCT	0	0
4-ATCT	0	0

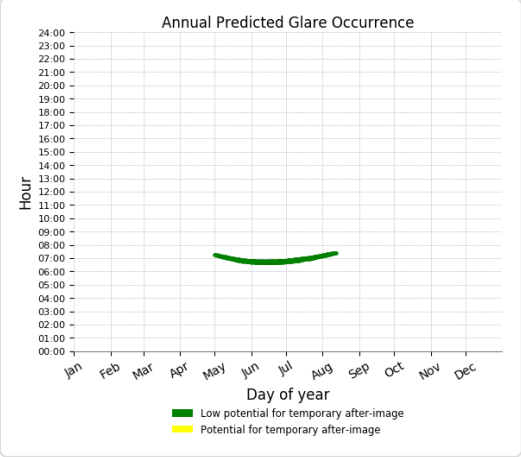
Results for: Panel Area 1

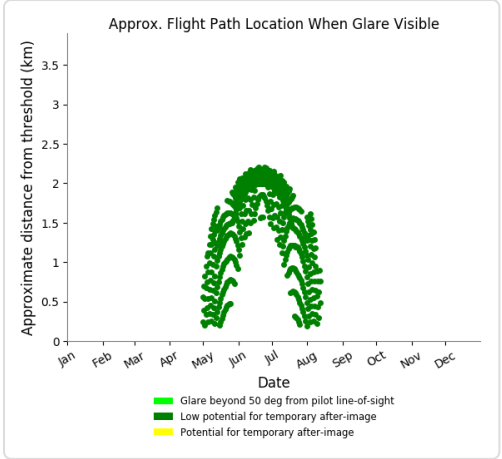
Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 05 Runway	697	0
Baldonnel 10L Runway	0	0
Baldonnel 10 Runway	0	0
Baldonnel 11 Runway	491	0
Dublin 16 Runway	0	0
Dublin 23 Runway	0	0
Dublin 28R Runway	0	0
Dublin 28 Runway	0	0
Dublin 29 Runway	0	0
Dublin 34 Runway	0	0
Weston 07 Runway	0	0
Weston 25 Runway	0	0
1-ATCT	0	0
2-ATCT	0	0
3-ATCT	0	0
4-ATCT	0	0

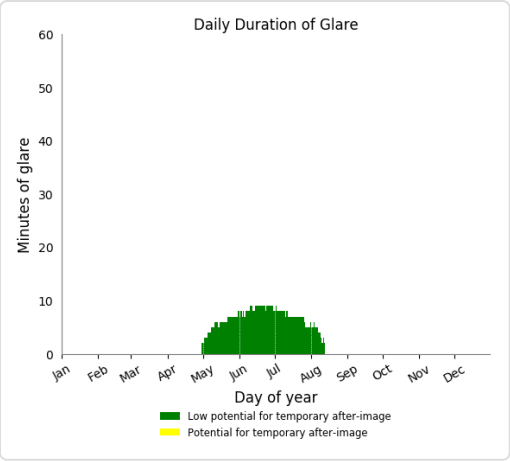
Flight Path: Baldonnel 05 Runway

0 minutes of yellow glare

697 minutes of green glare







Flight Path: Baldonnel 10L Runway

0 minutes of yellow glare

0 minutes of green glare

Flight Path: Baldonnel 10 Runway

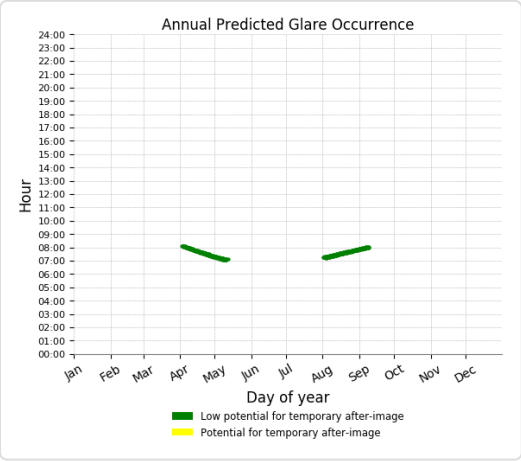
0 minutes of yellow glare

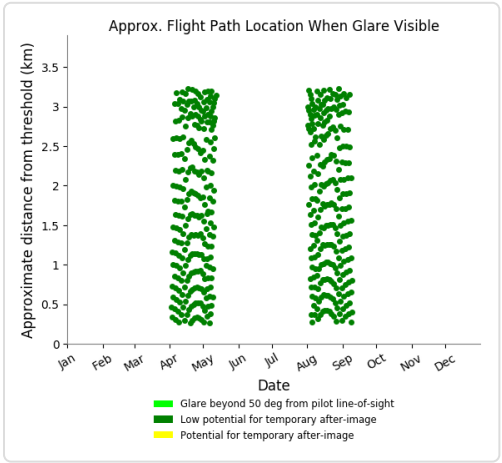
0 minutes of green glare

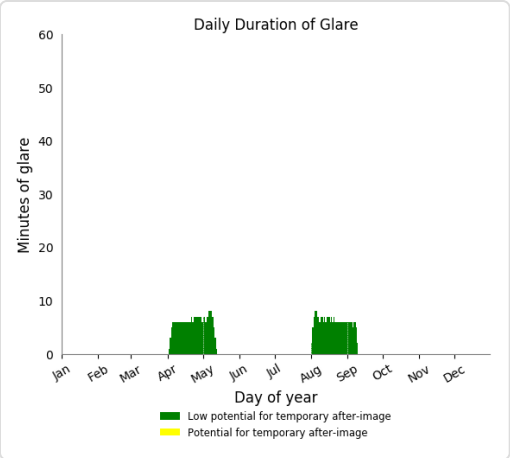
Flight Path: Baldonnel 11 Runway

0 minutes of yellow glare

491 minutes of green glare







Flight Path: Dublin 16 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 23 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28R Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 29 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 34 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 07 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 25 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 3-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 4-ATCT

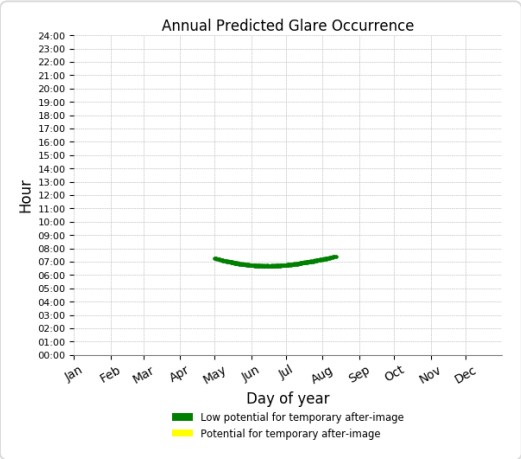
0 minutes of yellow glare
0 minutes of green glare

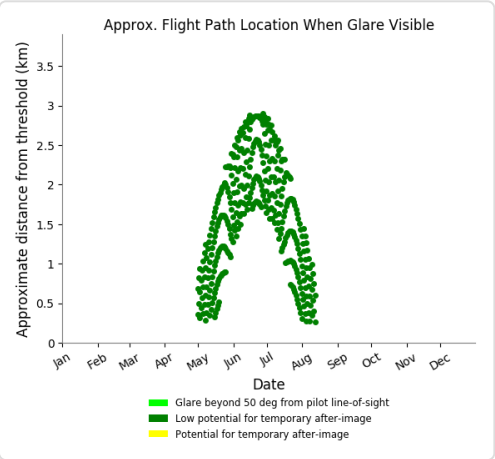
Results for: Panel Area 2

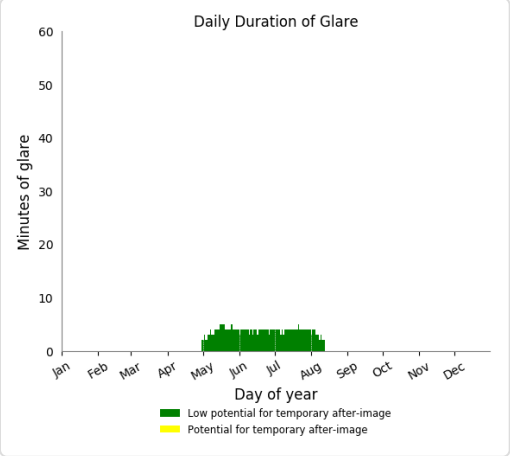
Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 05 Runway	393	0
Baldonnel 10L Runway	0	0
Baldonnel 10 Runway	0	0
Baldonnel 11 Runway	469	0
Dublin 16 Runway	0	0
Dublin 23 Runway	0	0
Dublin 28R Runway	0	0
Dublin 28 Runway	0	0
Dublin 29 Runway	0	0
Dublin 34 Runway	0	0
Weston 07 Runway	0	0
Weston 25 Runway	0	0
1-ATCT	0	0
2-ATCT	0	0
3-ATCT	0	0
4-ATCT	0	0

Flight Path: Baldonnel 05 Runway

0 minutes of yellow glare
393 minutes of green glare







Flight Path: Baldonnel 10L Runway

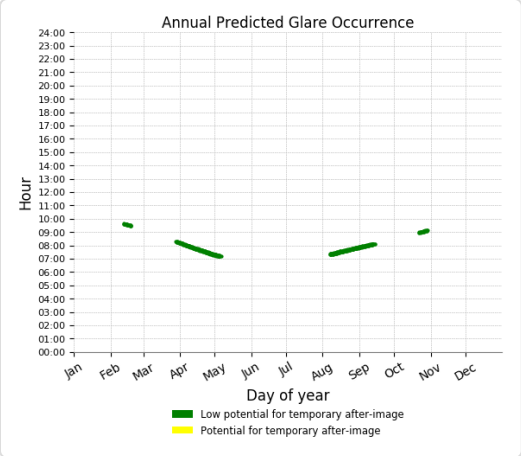
0 minutes of yellow glare
0 minutes of green glare

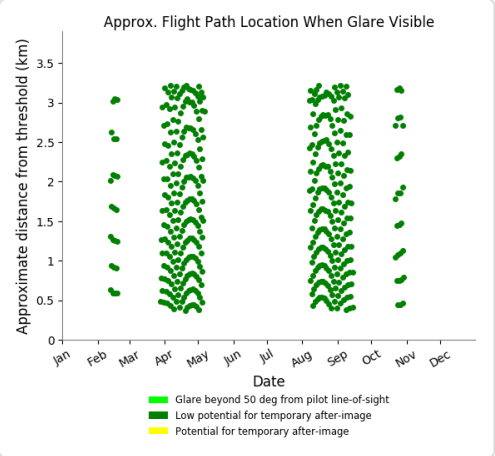
Flight Path: Baldonnel 10 Runway

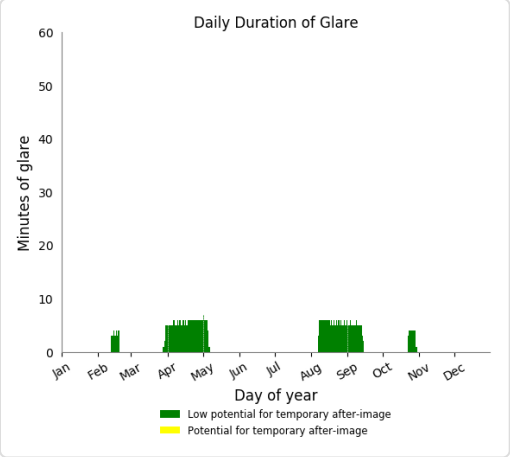
0 minutes of yellow glare
0 minutes of green glare

Flight Path: Baldonnel 11 Runway

0 minutes of yellow glare
469 minutes of green glare







Flight Path: Dublin 16 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 23 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28R Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 29 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 34 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 07 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 25 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 3-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 4-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: Panel Area 3

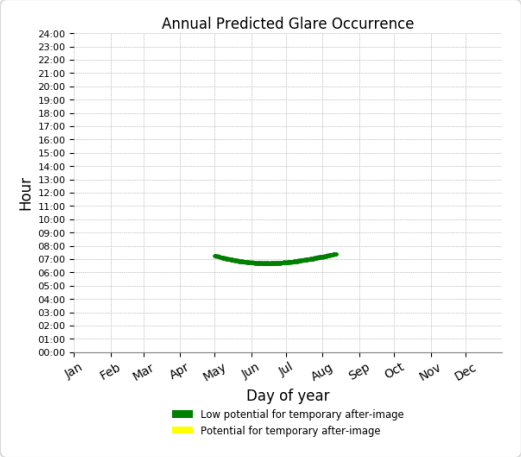
Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 05 Runway	464	0
Baldonnel 10L Runway	0	0

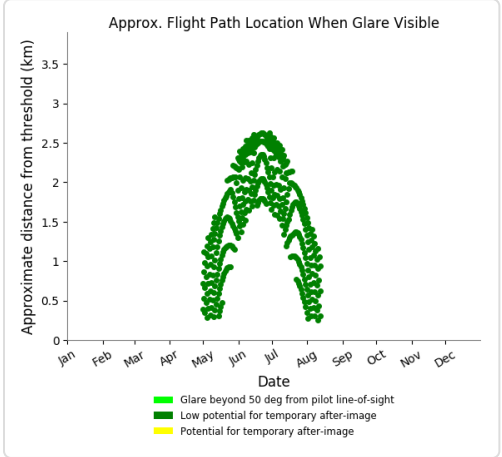
Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 10 Runway	0	0
Baldonnel 11 Runway	392	0
Dublin 16 Runway	0	0
Dublin 23 Runway	0	0
Dublin 28R Runway	0	0
Dublin 28 Runway	0	0
Dublin 29 Runway	0	0
Dublin 34 Runway	0	0
Weston 07 Runway	0	0
Weston 25 Runway	0	0
1-ATCT	0	0
2-ATCT	0	0
3-ATCT	0	0
4-ATCT	0	0

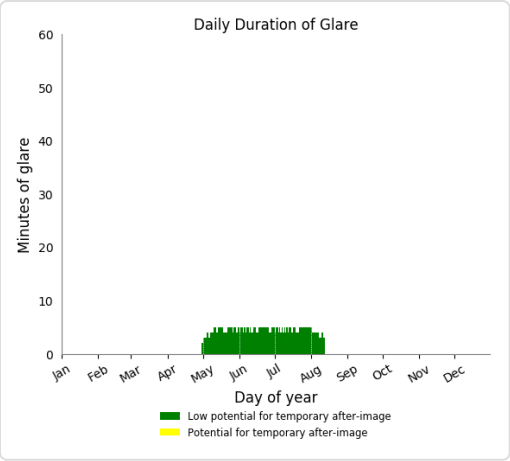
Flight Path: Baldonnel 05 Runway

0 minutes of yellow glare

464 minutes of green glare







Flight Path: Baldonnel 10L Runway

0 minutes of yellow glare

0 minutes of green glare

Flight Path: Baldonnel 10 Runway

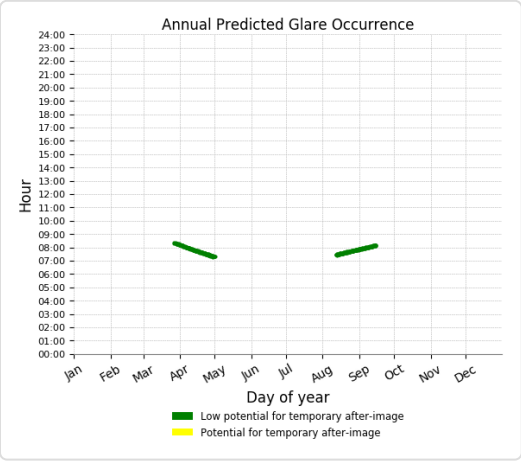
0 minutes of yellow glare

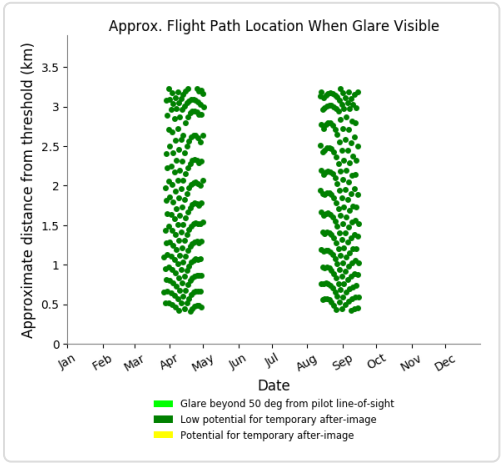
0 minutes of green glare

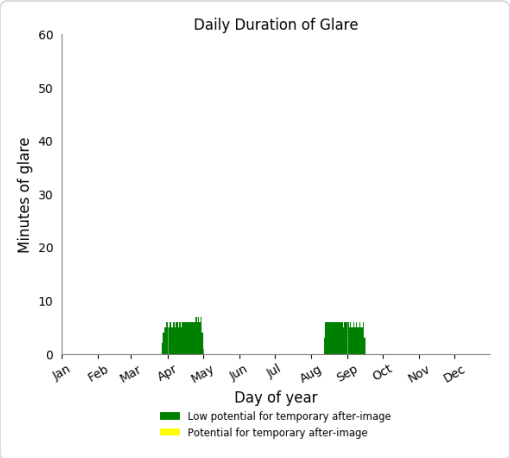
Flight Path: Baldonnel 11 Runway

0 minutes of yellow glare

392 minutes of green glare







Flight Path: Dublin 16 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 23 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28R Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 29 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 34 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 07 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 25 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 3-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 4-ATCT

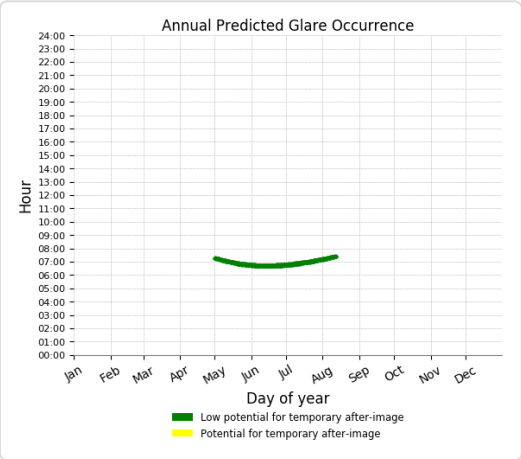
0 minutes of yellow glare
0 minutes of green glare

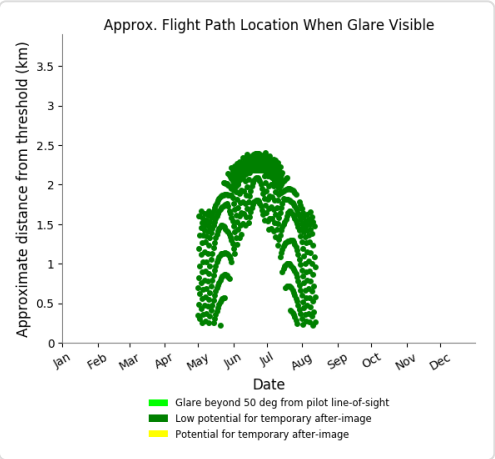
Results for: Panel Area 4

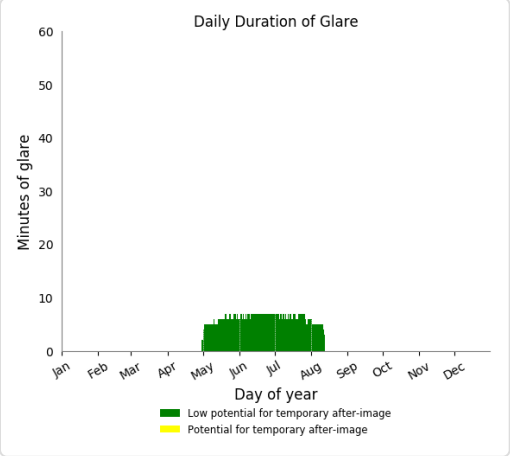
Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 05 Runway	646	0
Baldonnel 10L Runway	0	0
Baldonnel 10 Runway	0	0
Baldonnel 11 Runway	504	0
Dublin 16 Runway	0	0
Dublin 23 Runway	0	0
Dublin 28R Runway	0	0
Dublin 28 Runway	0	0
Dublin 29 Runway	0	0
Dublin 34 Runway	0	0
Weston 07 Runway	0	0
Weston 25 Runway	0	0
1-ATCT	0	0
2-ATCT	0	0
3-ATCT	0	0
4-ATCT	0	0

Flight Path: Baldonnel 05 Runway

0 minutes of yellow glare
646 minutes of green glare







Flight Path: Baldonnel 10L Runway

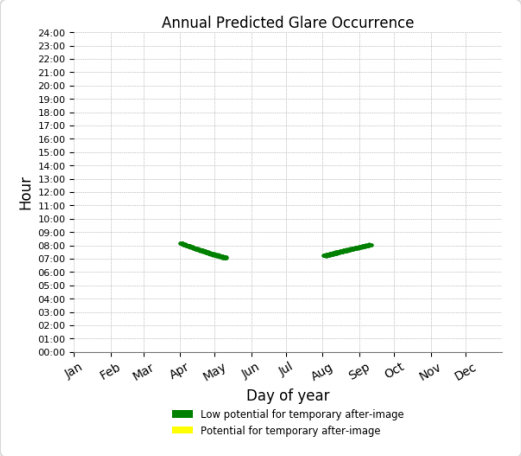
0 minutes of yellow glare
0 minutes of green glare

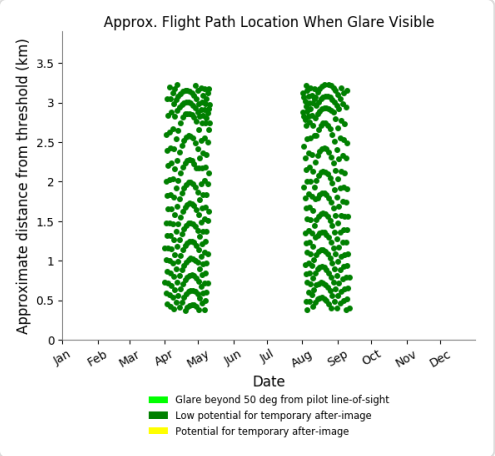
Flight Path: Baldonnel 10 Runway

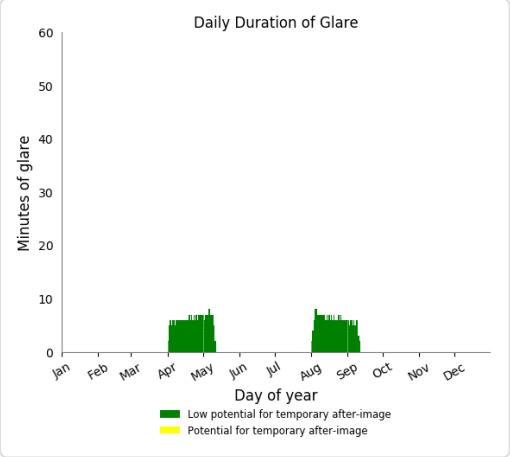
0 minutes of yellow glare
0 minutes of green glare

Flight Path: Baldonnel 11 Runway

0 minutes of yellow glare
504 minutes of green glare







Flight Path: Dublin 16 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 23 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28R Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 29 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 34 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 07 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 25 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 3-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 4-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: Panel Area 5

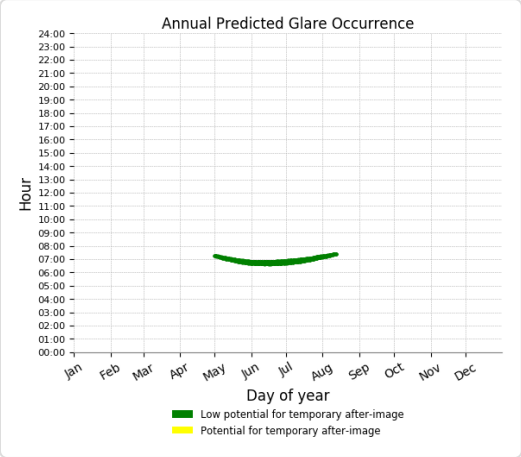
Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 05 Runway	892	0
Baldonnel 10L Runway	0	0

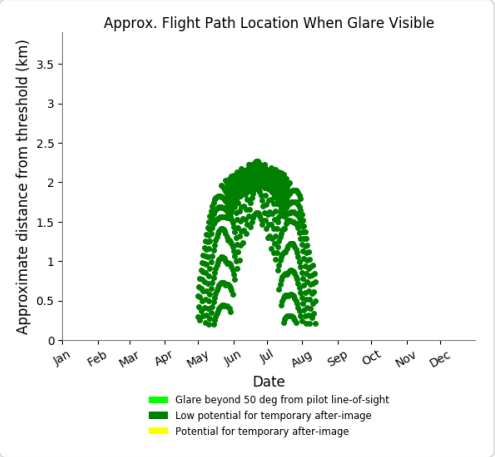
Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 10 Runway	0	0
Baldonnel 11 Runway	306	0
Dublin 16 Runway	0	0
Dublin 23 Runway	0	0
Dublin 28R Runway	0	0
Dublin 28 Runway	0	0
Dublin 29 Runway	0	0
Dublin 34 Runway	0	0
Weston 07 Runway	0	0
Weston 25 Runway	0	0
1-ATCT	0	0
2-ATCT	0	0
3-ATCT	0	0
4-ATCT	0	0

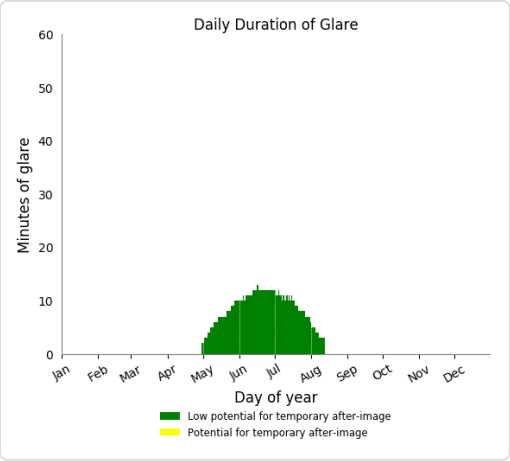
Flight Path: Baldonnel 05 Runway

0 minutes of yellow glare

892 minutes of green glare







Flight Path: Baldonnel 10L Runway

0 minutes of yellow glare

0 minutes of green glare

Flight Path: Baldonnel 10 Runway

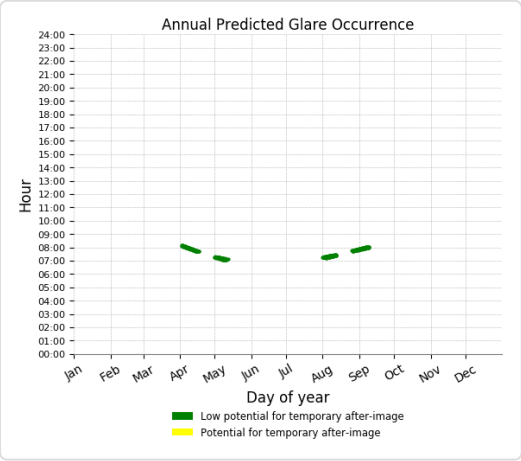
0 minutes of yellow glare

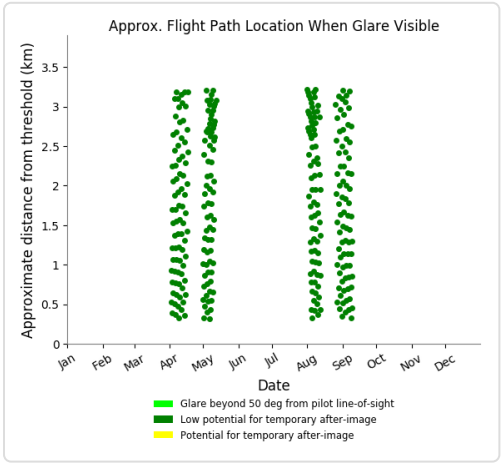
0 minutes of green glare

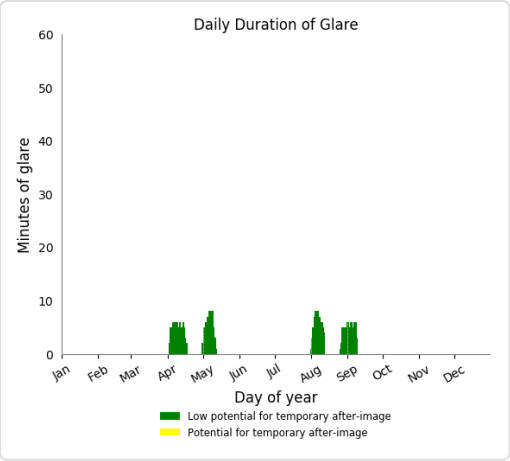
Flight Path: Baldonnel 11 Runway

0 minutes of yellow glare

306 minutes of green glare







Flight Path: Dublin 16 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 23 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28R Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 29 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 34 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 07 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 25 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 3-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 4-ATCT

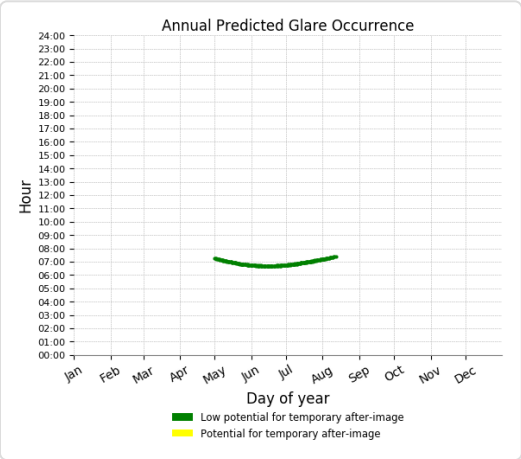
0 minutes of yellow glare
0 minutes of green glare

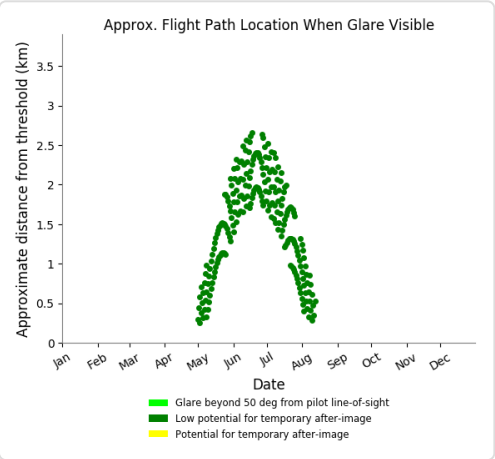
Results for: Panel Area 6

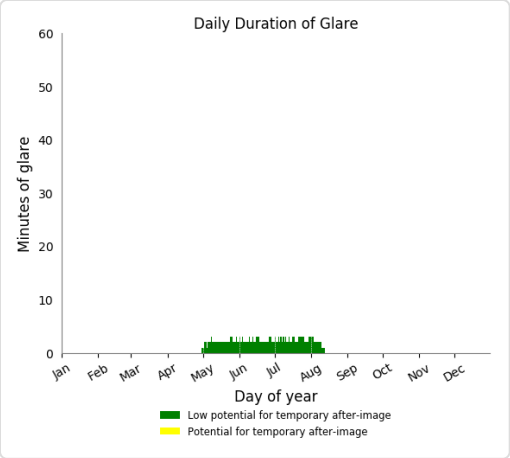
Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 05 Runway	234	0
Baldonnel 10L Runway	0	0
Baldonnel 10 Runway	0	0
Baldonnel 11 Runway	133	0
Dublin 16 Runway	0	0
Dublin 23 Runway	0	0
Dublin 28R Runway	0	0
Dublin 28 Runway	0	0
Dublin 29 Runway	0	0
Dublin 34 Runway	0	0
Weston 07 Runway	0	0
Weston 25 Runway	0	0
1-ATCT	0	0
2-ATCT	0	0
3-ATCT	0	0
4-ATCT	0	0

Flight Path: Baldonnel 05 Runway

0 minutes of yellow glare
234 minutes of green glare







Flight Path: Baldonnel 10L Runway

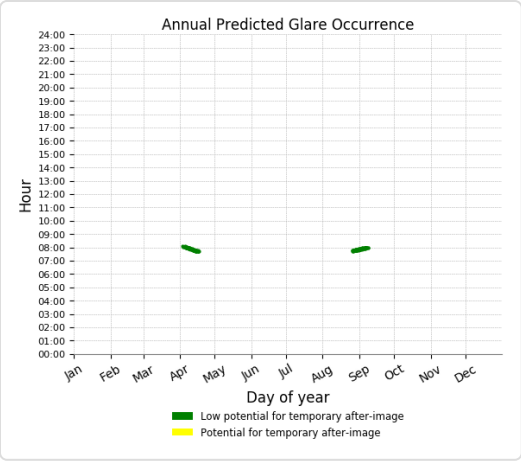
0 minutes of yellow glare
0 minutes of green glare

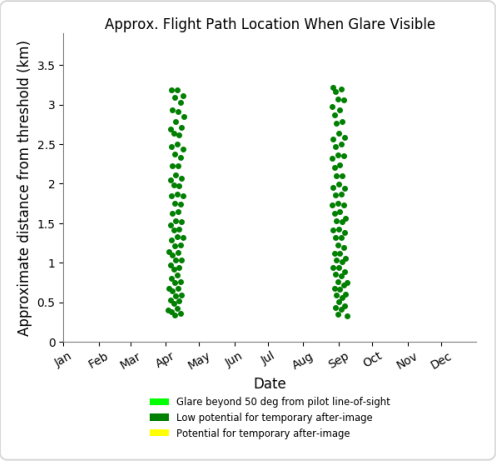
Flight Path: Baldonnel 10 Runway

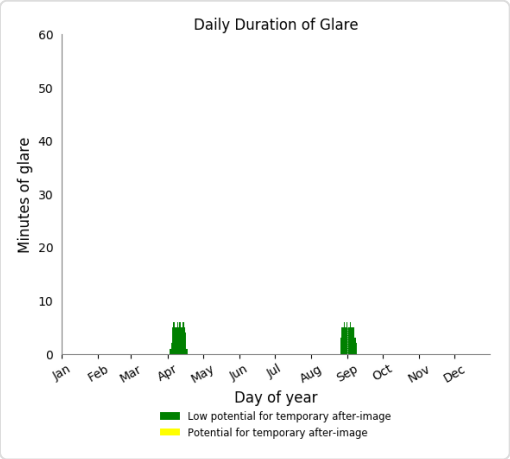
0 minutes of yellow glare
0 minutes of green glare

Flight Path: Baldonnel 11 Runway

0 minutes of yellow glare
133 minutes of green glare







Flight Path: Dublin 16 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 23 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28R Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 29 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 34 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 07 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 25 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 3-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 4-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: Panel Area 7

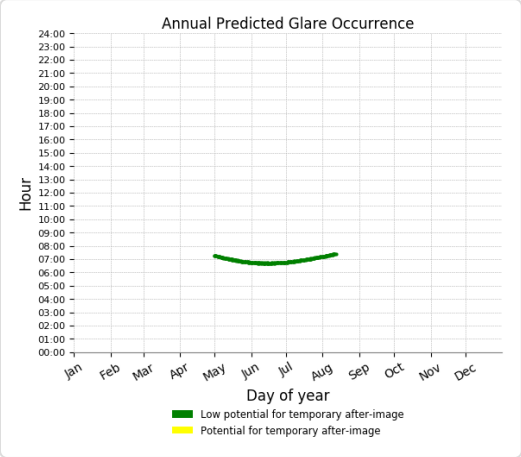
Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 05 Runway	237	0
Baldonnel 10L Runway	0	0

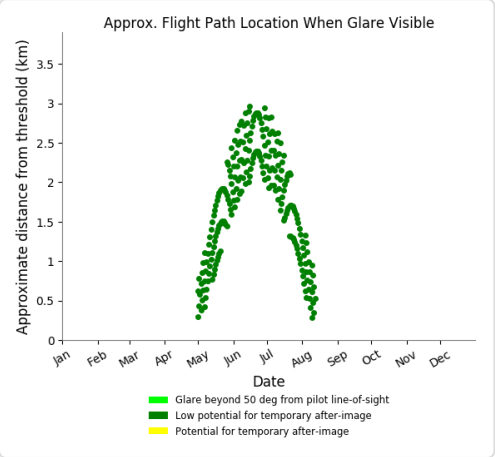
Receptor	Green Glare (min)	Yellow Glare (min)
Baldonnel 10 Runway	0	0
Baldonnel 11 Runway	122	0
Dublin 16 Runway	0	0
Dublin 23 Runway	0	0
Dublin 28R Runway	0	0
Dublin 28 Runway	0	0
Dublin 29 Runway	0	0
Dublin 34 Runway	0	0
Weston 07 Runway	0	0
Weston 25 Runway	0	0
1-ATCT	0	0
2-ATCT	0	0
3-ATCT	0	0
4-ATCT	0	0

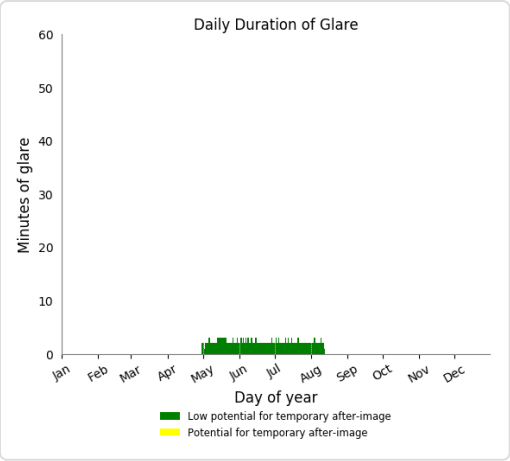
Flight Path: Baldonnel 05 Runway

0 minutes of yellow glare

237 minutes of green glare







Flight Path: Baldonnel 10L Runway

0 minutes of yellow glare

0 minutes of green glare

Flight Path: Baldonnel 10 Runway

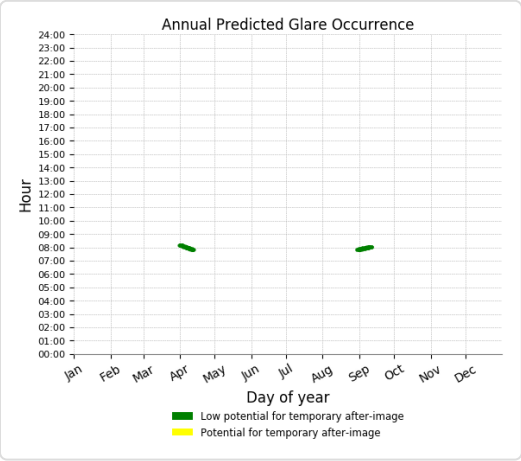
0 minutes of yellow glare

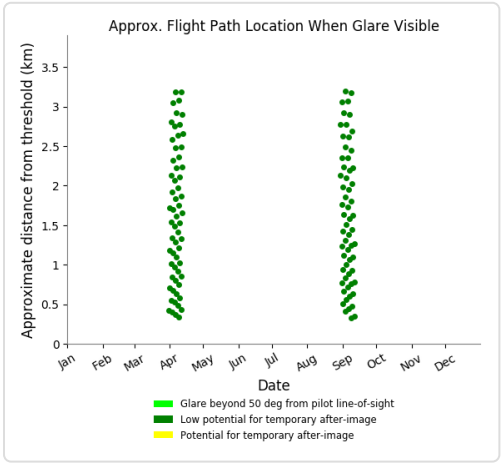
0 minutes of green glare

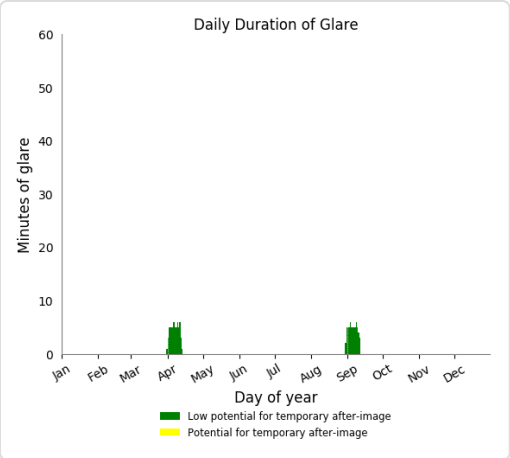
Flight Path: Baldonnel 11 Runway

0 minutes of yellow glare

122 minutes of green glare







Flight Path: Dublin 16 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 23 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28R Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 28 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 29 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Dublin 34 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 07 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 25 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 3-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 4-ATCT

0 minutes of yellow glare
0 minutes of green glare

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values may differ.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.

APPENDIX C:

GLINT AND GLARE MODEL ANALYSIS RESULTS OF AVIATION RECEPTOR POINTS IN THE SKIES NEAR THE HELIPAD AT TALLAGHT HOSPITAL (EAST AND WEST FACING PV PANELS)

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
0	128											
N250	128											
N500	128	2	2	82	41	Green	Feb13	May29-Jul13				
N750	128											
N1000	128											
N1250	128											
N1500	128											
NE250	128											
NE500	128											
NE750	128	3.2	4	48	15	Green	Jun13-Jun27					
NE1000	128	2.53	6	38	15	Green	Jan01-Jan03	Apr28-Apr29	Aug12-Aug13	Dec08-Dec12	Dec28-Dec31	
NE1250	128	2.47	6	42	17	Green	Apr17	May26-Jun01	Jul09-Jul15	Aug24-Aug25		
NE1500	128	2.91	6	32	11	Green	Apr10-Apr11	May14-May16	Jul25-Jul28	Aug30-Aug31		
E250	128											
E500	128											
E750	128											
E1000	128											
E1250	128											
E1500	128	2	2	24	12	Green	Jun15-Jun26					
SE250	128											
SE500	128											
SE750	128											
SE1000	128											
SE1250	128											
SE1500	128											

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
S250	128											
S500	128											
S750	128											
S1000	128											
S1250	128											
S1500	128											
SW250	128											
SW500	128											
SW750	128											
SW1000	128											
SW1250	128											
SW1500	128											
W250	128											
W500	128											
W750	128											
W1000	128											
W1250	128											
W1500	128											
NW250	128											
NW500	128											
NW750	128	2	2	20	10	Green	Apr15-Apr16	May15-May17	Jul25-Jul27	Aug25-Aug26		
NW1000	128	2	2	16	8	Green	Mar08	Apr26-Apr28	Aug14-Aug16	Oct04		
NW1250	128	2	2	16	8	Green	May04-May07	Aug05-Aug08				
NW1500	128	2	2	18	9	Green	May10-May14	Jul29-Aug01				

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
0	148											
N250	148	3.26	6	124	38	Green	Mar25-Apr12	Aug30-Sep17				
N500	148	2.63	6	134	51	Green	Jan22-Feb18	Jun11-Jul02	Oct23-Nov08	Nov19-Nov20		
N750	148	3.05	4	58	19	Green	Jan01-Jan08	Dec04-Dec13	Dec30-Dec31			
N1000	148											
N1250	148											
N1500	148											
NE250	148	5.6	10	504	90	Green	Apr03-May10	May22-May28	Jul14-Jul20	Aug02-Sep08		
NE500	148	3.27	6	144	44	Green	Feb07-Feb28	Oct14-Nov04				
NE750	148	3.95	6	146	37	Green	Jan11-Jan30	Nov12-Nov30				
NE1000	148	3.17	6	38	12	Green	Jan13-Jan14	Feb02	May02-May03	Aug08-Aug09	Nov08-Nov09	Nov27-Nov29
NE1250	148	2.53	6	48	19	Green	Jan26	Apr19	May25-May31	Jul10-Jul16	Aug22	Nov15-Nov16
NE1500	148	2.36	4	26	11	Green	Apr12-Apr13	May14-May16	Jul25-Jul28	Aug28-Aug29		
E250	148											
E500	148											
E750	148											
E1000	148											
E1250	148											
E1500	148											
SE250	148											
SE500	148											
SE750	148											
SE1000	148											
SE1250	148											
SE1500	148											

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
S250	148											
S500	148											
S750	148											
S1000	148											
S1250	148											
S1500	148											
SW250	148											
SW500	148											
SW750	148											
SW1000	148											
SW1250	148											
SW1500	148											
W250	148	2.29	4	16	7	Green	May26-May29	Jul14-Jul16				
W500	148											
W750	148											
W1000	148											
W1250	148											
W1500	148											
NW250	148											
NW500	148											
NW750	148	2	2	20	10	Green	Apr17-Apr18	May15-May17	Jul26-Jul27	Aug23-Aug25		
NW1000	148	2	2	14	7	Green	Apr27-Apr30	Aug12-Aug14				
NW1250	148	2	2	16	8	Green	May05-May08	Aug03-Aug06				
NW1500	148	2.44	4	22	9	Green	May12-May16	Jul27-Jul30				

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
0	168											
N250	168	4.19	8	218	52	Green	Mar24-May01	Aug10-Sep19				
N500	168	2.95	6	130	44	Green	Jan27-Feb23	Mar08-Mar14	Sep29-Oct04	Oct18-Nov03	Nov14	
N750	168	2.74	4	96	35	Green	Jan04-Jan16	Nov25-Dec28				
N1000	168											
N1250	168											
N1500	168											
NE250	168	8.66	14	1100	127	Green	Apr08-May28	Jun09-Jul02	Jul14-Sep03			
NE500	168	9.22	16	950	103	Green	Jan01-Jan23	Feb20-Mar09	Oct04-Oct21	Nov19-Dec31		
NE750	168	5.61	10	398	71	Green	Jan01-Jan09	Jan23-Feb07	Nov03-Nov18	Dec02-Dec31		
NE1000	168	4.28	8	184	43	Green	Jan20-Feb12	May06-May07	Aug04-Aug05	Oct29-Nov21		
NE1250	168	3.19	6	102	32	Green	Jan29-Feb14	Apr21-Apr22	May25-May30	Jul11-Jul16	Aug19-Aug20	Oct27-Nov12
NE1500	168	2.55	6	28	11	Green	Feb13	Apr14	May13-May15	Jul26-Jul29	Aug27	Oct28
E250	168											
E500	168											
E750	168											
E1000	168											
E1250	168											
E1500	168											
SE250	168											
SE500	168											
SE750	168											
SE1000	168											
SE1250	168											
SE1500	168											

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
S250	168											
S500	168											
S750	168											
S1000	168											
S1250	168											
S1500	168											
SW250	168											
SW500	168											
SW750	168											
SW1000	168											
SW1250	168											
SW1500	168											
W250	168	2.5	4	50	20	Green	May28-Jun04	Jun21-Jun24	Jul07-Jul14			
W500	168	2	2	8	4	Green	May15-May16	Jul26-Jul27				
W750	168	2	2	8	4	Green	May08-May09	Aug03-Aug04				
W1000	168	2	2	6	3	Green	May04	Aug07-Aug08				
W1250	168											
W1500	168											
NW250	168	3.95	6	158	40	Green	Apr15-May16	Jul26-Aug27				
NW500	168	2.82	4	62	22	Green	Mar30-Apr14	Aug27-Sep12				
NW750	168	2.25	4	18	8	Green	Apr19-Apr20	May15-May16	Jul27	Aug21-Aug23		
NW1000	168	2	2	14	7	Green	Apr29-May02	Aug10-Aug12				
NW1250	168	2.25	4	18	8	Green	May07-May10	Aug01-Aug04				
NW1500	168	2	2	20	10	Green	May14-May18	Jul25-Jul29				

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
0	188											
N250	188	4.45	10	298	67	Green	Mar24-May07	Aug05-Sep18				
N500	188	3.68	8	162	44	Green	Jan31-Feb02	Feb13-Feb28	Mar12-Mar17	Sep25-Sep30	Oct14-Oct29	Nov09-Nov10
N750	188	2.98	4	194	65	Green	Jan01-Jan23	Feb07-Feb13	Oct28-Nov03	Nov19-Dec31		
N1000	188											
N1250	188											
N1500	188											
NE250	188	11.98	18	1570	131	Green	Feb23-Feb24	Apr13-Aug29	Oct18			
NE500	188	9.62	42	1280	133	Green	Jan02-Feb09	Mar02-Mar18	Sep24-Oct10	Nov01-Dec31		
NE750	188	7.35	16	404	55	Green	Jan12-Feb14	Oct28-Nov30				
NE1000	188	4.44	8	182	41	Green	Jan28-Feb16	May10-May12	Jul30-Aug01	Oct25-Nov14		
NE1250	188	3.4	6	136	40	Green	Feb03-Feb18	Apr24	May24-May29	Jul12-Jul17	Aug17	Oct24-Nov08
NE1500	188	3.14	4	88	28	Green	Feb09-Feb18	Apr15-Apr16	May12-May15	Jul27-Jul29	Aug25-Aug26	Oct23-Nov01
E250	188											
E500	188	4.08	6	106	26	Green	Jun07-Jul02					
E750	188											
E1000	188											
E1250	188											
E1500	188	2.95	4	62	21	Green	Jun10-Jun30					
SE250	188											
SE500	188											
SE750	188											
SE1000	188											
SE1250	188											
SE1500	188											

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
S250	188											
S500	188											
S750	188											
S1000	188											
S1250	188											
S1500	188											
SW250	188											
SW500	188											
SW750	188											
SW1000	188											
SW1250	188											
SW1500	188											
W250	188	2.97	4	104	35	Green	Jun03-Jul09					
W500	188	3.96	6	178	45	Green	May18-Jul25					
W750	188	2.67	4	8	3	Green	May10	Aug01-Aug02				
W1000	188	2	2	8	4	Green	May05-May06	Aug06-Aug07				
W1250	188	2.67	4	8	3	Green	May02	Aug09-Aug10				
W1500	188											
NW250	188	4.15	8	220	53	Green	Apr15-May22	Jul21-Aug27				
NW500	188	3.38	6	98	29	Green	Apr01-Apr19	Aug23-Sep10	Sep22-Sep23			
NW750	188	2.59	4	88	34	Green	Mar19-Apr02	Apr21-Apr23	May14-May16	Jul26-Jul28	Aug19-Aug21	Sep09-Sep24
NW1000	188	2.5	4	70	28	Green	Mar10-Mar23	May01-May04	Aug08-Aug11	Sep19-Oct02		
NW1250	188	2.43	4	34	14	Green	Mar05-Mar07	May09-May12	Jul30-Aug02	Oct05-Oct07		
NW1500	188	2	2	20	10	Green	May16-May20	Jul23-Jul27				

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
0	208											
N250	208	5.03	10	332	66	Green	Mar27-May12	Jul30-Sep15				
N500	208	3.45	6	176	51	Green	Jan26-Feb05	Feb17-Mar03	Mar16-Mar21	Sep21-Sep26	Oct09-Oct24	Nov05-Nov16
N750	208	3.32	6	146	44	Green	Jan11-Jan28	Feb11-Feb17	Oct25-Oct30	Nov14-Dec02		
N1000	208	2.89	4	52	18	Green	Jan13-Jan22	Nov20-Nov29				
N1250	208											
N1500	208											
NE250	208	10.97	18	1514	138	Green	Mar07-Mar25	Apr19-Apr26	May07-Aug04	Aug15-Aug23	Sep17-Oct05	
NE500	208	12.61	64	1866	148	Green	Jan01-Feb23	Mar13-Mar27	Sep15-Sep29	Oct18-Dec31		
NE750	208	7.91	16	364	46	Green	Jan26-Feb20	Oct21-Nov15				
NE1000	208	5	8	200	40	Green	Feb03-Feb20	May14-May16	Jul25-Jul28	Oct21-Nov08		
NE1250	208	3.71	6	152	41	Green	Feb06-Feb20	Apr26-Apr27	May23-May27	Jul14-Jul18	Aug14-Aug15	Oct20-Nov04
NE1500	208	3.66	6	106	29	Green	Feb12-Feb21	Apr17-Apr18	May12-May14	Jul27-Jul30	Aug23-Aug24	Oct20-Oct29
E250	208	4.8	8	144	30	Green	Jun06-Jul05					
E500	208											
E750	208	2.8	4	28	10	Green	May09-May13	Jul28-Aug01				
E1000	208											
E1250	208											
E1500	208											
SE250	208											
SE500	208											
SE750	208											
SE1000	208											
SE1250	208											
SE1500	208											

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
S250	208											
S500	208											
S750	208											
S1000	208											
S1250	208											
S1500	208											
SW250	208											
SW500	208											
SW750	208											
SW1000	208											
SW1250	208											
SW1500	208											
W250	208	2.53	4	48	19	Green	Jun12-Jun30					
W500	208	2.67	4	40	15	Green	May19-May30	Jul13-Jul24				
W750	208	3.58	6	190	53	Green	May11-May13	May28-Jul14	Jul30-Jul31			
W1000	208	3.18	4	70	22	Green	May07	May21-May29	Jul13-Jul22	Aug04-Aug05		
W1250	208	2	2	6	3	Green	May03	Aug08-Aug09				
W1500	208	2	2	6	3	Green	Apr30-May01	Aug11				
NW250	208	5	10	290	58	Green	Apr17-May29	Jul14-Aug24				
NW500	208	3.39	6	112	33	Green	Mar21-Apr21	Aug20-Sep21				
NW750	208	2.84	6	88	31	Green	Mar21-Apr04	Apr23-Apr25	May14-May16	Jul27-Jul28	Aug17-Aug19	Sep06-Sep21
NW1000	208	2.5	4	60	24	Green	Mar12-Mar25	May03-May06	Aug06-Aug08	Sep18-Sep30		
NW1250	208	2.24	4	56	25	Green	Mar06-Mar17	May11-May15	Jul28-Jul31	Sep25-Oct06		
NW1500	208	2.67	4	56	21	Green	Mar02-Mar06	May18-May22	Jul20-Jul25	Oct06-Oct10		

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
0	228											
N250	228	5.86	10	404	69	Green	Mar30-May19	Jul23-Sep12				
N500	228	3.72	8	212	57	Green	Jan28-Feb10	Feb22-Mar07	Mar19-Mar24	Sep18-Sep23	Oct05-Oct19	Nov01-Nov13
N750	228	3.56	6	160	45	Green	Jan18-Feb02	Feb14-Feb20	Oct21-Oct27	Nov09-Nov24		
N1000	228	3.16	4	60	19	Green	Jan18-Jan26	Nov16-Nov23	Dec20-Dec24			
N1250	228											
N1500	228											
NE250	228	10.6	22	1282	121	Green	Mar18-Apr07	Apr25-May02	May15-Jul28	Aug09-Aug17	Sep05-Sep24	
NE500	228	12.6	66	1878	149	Green	Jan01-Jan10	Jan24-Mar05	Mar22-Apr04	Sep07-Sep20	Oct07-Nov17	Dec01-Dec31
NE750	228	7.05	14	430	61	Green	Feb05-Feb26	Oct15-Nov05	Dec12-Dec30			
NE1000	228	4.9	10	196	40	Green	Feb08-Feb24	May19-May22	Jul20-Jul23	Oct17-Nov02		
NE1250	228	3.45	8	162	47	Green	Jan01-Jan02	Feb10-Feb23	Apr28-Apr29	May23-May26	Jul15-Jul19	Aug12
NE1500	228	3.27	6	98	30	Green	Feb11-Feb23	Apr19-Apr20	May12-May14	Jul28-Jul30	Aug21-Aug22	Oct18-Oct30
E250	228											
E500	228											
E750	228	3.68	6	140	38	Green	May11-May29	Jul12-Jul31				
E1000	228											
E1250	228											
E1500	228											
SE250	228											
SE500	228											
SE750	228											
SE1000	228											
SE1250	228											
SE1500	228											

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
S250	228											
S500	228											
S750	228											
S1000	228											
S1250	228											
S1500	228											
SW250	228											
SW500	228											
SW750	228											
SW1000	228											
SW1250	228											
SW1500	228											
W250	228											
W500	228	2.57	4	54	21	Green	May21-Jun04	Jul07-Jul21				
W750	228	4.72	8	236	50	Green	May12-May20	Jun02-Jul09	Jul23-Jul30			
W1000	228	3.82	6	130	34	Green	May08-May09	May24-Jun07	Jul04-Jul18	Aug03-Aug04		
W1250	228	2.92	4	76	26	Green	May04-May05	May19-May29	Jul14-Jul24	Aug07-Aug08		
W1500	228	2	2	6	3	Green	May01-May02	Aug10				
NW250	228	5.48	10	362	66	Green	Apr20-Jun07	Jul04-Aug22				
NW500	228	3.38	6	132	39	Green	Mar21-Apr24	Aug17-Sep21				
NW750	228	2.78	6	100	36	Green	Mar06	Mar23-Apr06	Apr25-Apr27	May14-May15	Jul27-Jul29	Aug15-Aug17
NW1000	228	2.57	6	72	28	Green	Mar14-Mar26	May05-May08	Aug03-Aug07	Sep16-Sep28		
NW1250	228	2.62	4	68	26	Green	Mar08-Mar18	May13-May17	Jul26-Jul30	Sep23-Oct04		
NW1500	228	2.64	4	66	25	Green	Mar03-Mar13	May20-May24	Jul18-Jul22	Sep29-Oct09		

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
0	248											
N250	248	6.27	12	508	81	Green	Apr02-May27	Jul15-Sep09				
N500	248	4.67	8	458	98	Green	Jan01-Jan10	Feb02-Feb13	Feb27-Mar28	Sep14-Sep19	Oct01-Oct14	Oct28-Nov09
N750	248	3.72	6	160	43	Green	Jan24-Feb06	Feb18-Feb24	Oct18-Oct24	Nov04-Nov18		
N1000	248	2.88	4	98	34	Green	Jan01-Jan06	Jan23-Jan30	Nov12-Nov19	Dec05-Dec13	Dec29-Dec31	
N1250	248	2.43	4	68	28	Green	Jan01-Jan04	Dec08-Dec31				
N1500	248											
NE250	248	11.12	26	1056	95	Green	Mar02-Mar15	Mar27-Apr18	Apr30-May08	May23-May29	Jul13-Jul19	Aug03-Aug11
NE500	248	13.8	56	2304	167	Green	Jan01-Mar16	Mar31-Apr13	Aug29-Sep11	Sep27-Nov03	Nov14-Dec31	
NE750	248	8.46	16	702	83	Green	Jan01-Jan20	Feb13-Mar03	Oct09-Oct28	Nov22-Dec12	Dec30-Dec31	
NE1000	248	4.3	10	262	61	Green	Feb13-Feb28	May24-May28	Jul14-Jul17	Oct13-Oct29	Dec12-Dec30	
NE1250	248	3.51	6	172	49	Green	Jan07-Jan10	Feb13-Feb26	May01-May02	May21-May25	Jul16-Jul20	Aug09-Aug10
NE1500	248	3.63	6	98	27	Green	Feb14-Feb25	Apr21	May11-May13	Jul28-Jul30	Aug20	Oct16-Oct27
E250	248	3.47	4	118	34	Green	Jun04-Jul07					
E500	248											
E750	248	4.45	8	236	53	Green	May16-Jun10	Jun30-Jul26				
E1000	248											
E1250	248											
E1500	248											
SE250	248											
SE500	248											
SE750	248											
SE1000	248											
SE1250	248											
SE1500	248											

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
S250	248											
S500	248											
S750	248											
S1000	248											
S1250	248											
S1500	248											
SW250	248											
SW500	248											
SW750	248											
SW1000	248											
SW1250	248											
SW1500	248											
W250	248											
W500	248	2.37	4	64	27	Green	May25-Jun12	Jun29-Jul18				
W750	248	3.44	6	124	36	Green	May14-May22	Jun09-Jul01	Jul20-Jul28			
W1000	248	3.64	8	200	55	Green	May08-May14	May27-Jul14	Jul28-Aug03			
W1250	248	3.41	6	92	27	Green	May05-May06	May21-Jun01	Jul10-Jul21	Aug06		
W1500	248	3.45	6	76	22	Green	May02-May03	May17-May26	Jul17-Jul25	Aug09		
NW250	248	5.83	14	466	80	Green	Apr23-May03	May16-Jul27	Aug09-Aug19			
NW500	248	3.79	10	144	38	Green	Mar23-Mar30	Apr10-Apr27	Aug15-Sep01	Sep12-Sep19		
NW750	248	2.74	8	104	38	Green	Mar07-Mar12	Mar25-Apr08	Apr27-Apr29	May13-May15	Jul28-Jul29	Aug13-Aug14
NW1000	248	2.85	6	94	33	Green	Mar16-Mar28	May07-May10	Jun17-Jun22	Aug02-Aug05	Sep14-Sep27	
NW1250	248	2.74	4	74	27	Green	Mar09-Mar20	May15-May18	Jul24-Jul28	Sep22-Oct03		
NW1500	248	2.64	4	74	28	Green	Mar04-Mar14	May22-May27	Jul16-Jul21	Sep28-Oct08		

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
0	268											
N250	268	6.65	16	672	101	Green	Feb26-Mar06	Apr06-Jun08	Jul04-Sep05	Oct07-Oct15		
N500	268	5.59	14	436	78	Green	Jan13-Jan23	Feb06-Feb16	Mar02-Mar15	Mar26-Mar31	Sep11-Sep16	Sep27-Oct10
N750	268	3.74	6	146	39	Green	Jan29-Feb10	Feb21-Feb26	Oct15-Oct20	Oct31-Nov13		
N1000	268	3.87	6	182	47	Green	Jan01-Jan13	Jan27-Feb02	Nov08-Nov14	Nov28-Dec31		
N1250	268	3.35	6	134	40	Green	Jan01-Jan10	Dec02-Dec31				
N1500	268											
NE250	268	11.08	26	1374	124	Green	Mar08-Mar21	Apr02-May14	Jun02-Jun15	Jun26-Jul09	Jul28-Sep10	Sep21-Oct04
NE500	268	13.4	52	2332	174	Green	Jan01-Mar25	Apr08-Apr21	Aug21-Sep02	Sep17-Dec14	Dec29-Dec31	
NE750	268	7.56	16	718	95	Green	Jan01-Jan07	Jan20-Feb01	Feb21-Mar08	Oct04-Oct21	Nov09-Nov21	Dec04-Dec31
NE1000	268	4.72	10	274	58	Green	Jan05-Jan12	Feb17-Mar02	May30-Jun05	Jul06-Jul11	Oct09-Oct24	Nov30-Dec07
NE1250	268	3.69	8	262	71	Green	Jan01-Jan16	Feb16-Feb29	May03-May04	May20-May24	Jul18-Jul22	Aug06-Aug07
NE1500	268	3.29	6	138	42	Green	Jan05-Jan18	Feb16-Feb27	Apr23	May10-May13	Jul29-Jul31	Aug18
E250	268	2.17	4	26	12	Green	Jun16-Jun27					
E500	268											
E750	268	5.17	12	414	80	Green	Apr27-May06	May21-Jul20	Aug05-Aug13			
E1000	268											
E1250	268											
E1500	268											
SE250	268											
SE500	268											
SE750	268											
SE1000	268											
SE1250	268											
SE1500	268											

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
S250	268											
S500	268											
S750	268											
S1000	268											
S1250	268											
S1500	268											
SW250	268											
SW500	268											
SW750	268											
SW1000	268											
SW1250	268											
SW1500	268											
W250	268											
W500	268	3.17	6	92	29	Green	May28-Jun03	Jun14-Jul14				
W750	268	2.27	4	34	15	Green	May16-May25	Jul17-Jul27				
W1000	268	4.94	8	242	49	Green	May10-May16	Jun01-Jul10	Jul26-Aug02			
W1250	268	3.43	8	120	35	Green	May06-May11	May24-Jun05	Jul06-Jul18	Aug01-Aug06		
W1500	268	3.83	6	88	23	Green	May03-May04	May20-May29	Jul14-Jul23	Aug08		
NW250	268	7.63	14	572	75	Green	Apr25-May06	May22-Jul20	Aug05-Aug16			
NW500	268	4.21	10	160	38	Green	Mar25-Apr01	Apr13-Apr30	Aug12-Aug29	Sep10-Sep17		
NW750	268	2.88	8	124	43	Green	Mar08-Mar13	Mar27-Apr10	Apr29-May02	May13-May14	Jul28-Jul30	Aug10-Aug12
NW1000	268	2.67	6	112	42	Green	Feb26	Mar17-Mar30	May09-May12	Jun16-Jun27	Jul30-Aug02	Sep12-Sep25
NW1250	268	2.72	4	68	25	Green	Mar11-Mar21	May17-May21	Jul21-Jul25	Sep21-Oct02		
NW1500	268	2.8	4	84	30	Green	Mar05-Mar16	May24-May29	Jul13-Jul19	Sep27-Oct07		

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
0	288	5.15	6	134	26	Green	Apr24-May06	Aug05-Aug17				
N250	288	6.98	16	796	114	Green	Mar04-Mar12	Apr09-Jun02	Jun14-Jun27	Jul09-Sep02	Sep30-Oct09	
N500	288	5.66	14	436	77	Green	Jan23-Feb20	Mar06-Mar19	Mar30-Apr04	Sep07-Oct06	Oct21-Nov19	
N750	288	3.74	6	146	39	Green	Feb02-Mar01	Oct12-Nov08				
N1000	288	4.41	8	194	44	Green	Jan01-Jan19	Jan31-Feb05	Nov05-Nov11	Nov23-Dec11	Dec30-Dec31	
N1250	288	3.04	4	70	23	Green	Jan04-Jan15	Nov27-Dec07				
N1500	288											
NE250	288	12.15	26	1276	105	Green	Mar14-Mar27	Apr07-May20	Jul22-Sep04	Sep15-Sep28		
NE500	288	13.87	52	2066	149	Green	Jan23-Apr03	Apr17-Apr28	Aug13-Aug25	Sep08-Nov19		
NE750	288	12.19	26	1390	114	Green	Jan01-Jan20	Jan31-Feb10	Feb27-Mar13	Sep28-Oct14	Oct31-Nov10	Nov21-Dec31
NE1000	288	4.56	10	438	96	Green	Jan01-Jan19	Feb21-Mar06	Jun08-Jul03	Oct06-Oct19	Nov23-Dec31	
NE1250	288	3.8	8	228	60	Green	Jan03-Jan20	Feb20-Mar02	May06-May07	May19-May23	Jul19-Jul23	Aug04-Aug05
NE1500	288	3.6	8	144	40	Green	Jan10-Jan21	Feb18-Feb29	Apr24-Apr25	May10-May12	Jul30-Aug01	Aug16-Aug17
E250	288											
E500	288											
E750	288	6.31	12	574	91	Green	Apr19-May13	May28-Jul14	Jul29-Aug22			
E1000	288	2	2	4	2	Green	Apr16	Aug25				
E1250	288											
E1500	288											
SE250	288											
SE500	288											
SE750	288											
SE1000	288											
SE1250	288											
SE1500	288											

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
S250	288											
S500	288											
S750	288											
S1000	288											
S1250	288											
S1500	288											
SW250	288											
SW500	288											
SW750	288											
SW1000	288											
SW1250	288											
SW1500	288											
W250	288											
W500	288	2.73	4	60	22	Green	May30-Jun09	Jul02-Jul12				
W750	288	2.53	4	38	15	Green	May18-May28	Jul14-Jul24				
W1000	288	4.73	8	208	44	Green	May11-May18	Jun05-Jul06	Jul24-Jul31			
W1250	288	3.9	8	156	40	Green	May07-May12	May27-Jun11	Jun30-Jul15	Jul30-Aug04		
W1500	288	3.64	6	102	28	Green	May04-May08	May22-May31	Jul11-Jul20	Aug03-Aug08		
NW250	288	5.86	12	340	58	Green	Apr28-May09	May31-Jul12	Aug02-Aug14			
NW500	288	4.27	10	158	37	Green	Mar27-Apr02	Apr16-May03	Aug09-Aug26	Sep09-Sep15		
NW750	288	2.93	8	126	43	Green	Mar09-Mar15	Mar29-Apr12	May02-May14	Jul29-Aug10	Aug29-Sep13	Sep27-Oct03
NW1000	288	2.65	6	130	49	Green	Feb27-Mar03	Mar19-Mar31	May11-May14	Jun14-Jun29	Jul28-Jul31	Sep11-Sep23
NW1250	288	2.8	6	84	30	Green	Mar12-Mar23	May20-May24	Jul18-Jul23	Sep19-Sep30	Oct23	
NW1500	288	2.84	6	88	31	Green	Mar06-Mar16	May26-Jun01	Jul10-Jul16	Sep25-Oct06		

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
0	308	5.56	8	200	36	Green	Apr16-May14	Jul28-Aug26				
N250	308	7.48	18	920	123	Green	Mar10-Mar18	Apr12-Aug30	Sep24-Oct03			
N500	308	5.79	16	434	75	Green	Jan31-Feb23	Mar10-Apr07	Sep04-Oct02	Oct18-Nov11		
N750	308	7.89	16	552	70	Green	Jan01-Jan07	Feb07-Mar03	Oct09-Nov04	Dec05-Dec31		
N1000	308	4.11	8	156	38	Green	Jan09-Jan23	Feb03-Feb09	Nov02-Dec03			
N1250	308	3.37	6	64	19	Green	Jan11-Jan19	Nov22-Dec01				
N1500	308											
NE250	308	12.71	24	1436	113	Green	Mar19-May27	Jul15-Sep23				
NE500	308	14.11	50	2032	144	Green	Feb03-Apr11	Apr24-May06	Aug05-Aug17	Aug31-Nov07		
NE750	308	11.38	28	1070	94	Green	Jan06-Jan29	Feb09-Feb18	Mar04-Mar18	Sep23-Oct08	Oct23-Nov01	Nov13-Dec05
NE1000	308	4.41	10	282	64	Green	Jan07-Jan24	Feb26-Mar09	Jun14-Jun28	Oct02-Oct15	Nov17-Dec05	
NE1250	308	4.12	8	214	52	Green	Jan10-Jan24	Feb22-Mar05	May09-May21	Jul20-Aug02	Oct07-Oct18	Nov17-Dec01
NE1500	308	3.76	8	158	42	Green	Jan13-Jan24	Feb21-Mar02	Apr26-Apr27	May09-May11	Jul30-Aug01	Aug14-Aug15
E250	308											
E500	308											
E750	308	5.47	10	432	79	Green	Apr24-May20	Jun04-Jul06	Jul21-Aug17			
E1000	308	2.36	4	26	11	Green	Apr17-May02	Aug08-Aug23				
E1250	308											
E1500	308											
SE250	308											
SE500	308											
SE750	308											
SE1000	308											
SE1250	308											
SE1500	308											

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
S250	308											
S500	308											
S750	308											
S1000	308											
S1250	308											
S1500	308											
SW250	308											
SW500	308											
SW750	308											
SW1000	308											
SW1250	308											
SW1500	308											
W250	308											
W500	308	2.84	4	108	38	Green	May28-Jul14					
W750	308	2.44	4	44	18	Green	May20-Jun01	Jul11-Jul22				
W1000	308	2.6	4	78	30	Green	May13-May20	Jun12-Jun29	Jul22-Jul30			
W1250	308	4.38	8	228	52	Green	May08-May14	May31-Jul12	Jul29-Aug04			
W1500	308	3.38	6	108	32	Green	May05-May10	May24-Jun04	Jul08-Jul18	Aug02-Aug07		
NW250	308	3.68	6	114	31	Green	May01-May13	Jun13-Jun28	Jul30-Aug11			
NW500	308	4.59	12	188	41	Green	Mar28-Apr04	Apr19-May06	Aug06-Aug23	Sep06-Sep14		
NW750	308	2.98	10	134	45	Green	Mar10-Mar16	Mar31-Apr14	May04-May14	Jul29-Aug08	Aug27-Sep10	Sep26-Oct02
NW1000	308	2.69	8	148	55	Green	Feb28-Mar04	Mar21-Apr02	May14-May17	Jun11-Jun30	Jul25-Jul29	Sep09-Sep22
NW1250	308	2.56	6	82	32	Green	Feb19-Feb20	Mar13-Mar24	May22-May27	Jul17-Jul21	Sep18-Sep29	Oct22
NW1500	308	2.91	4	96	33	Green	Mar08-Mar18	May29-Jun04	Jul06-Jul14	Sep24-Oct05		

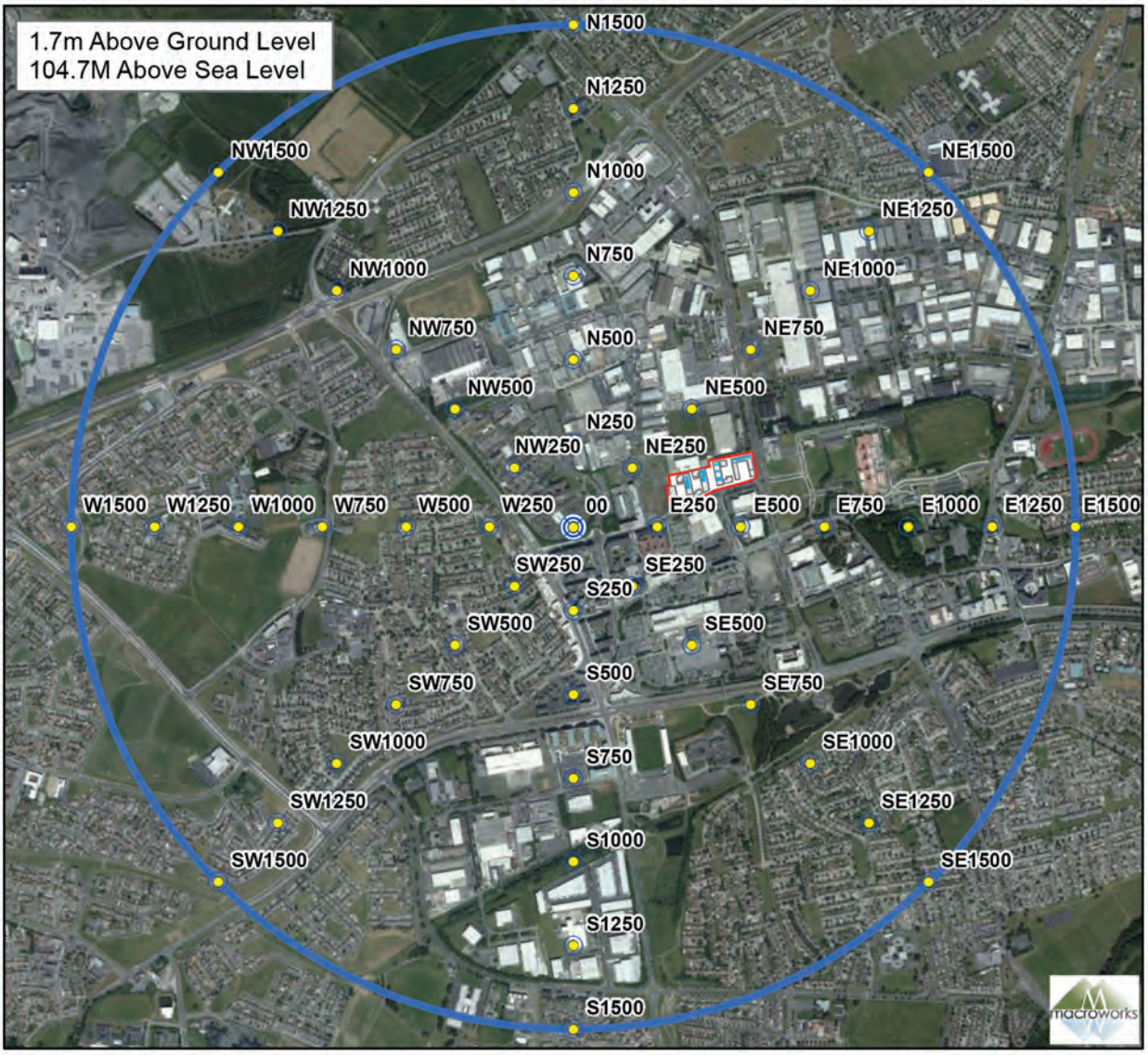
Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
0	328	5.51	10	358	65	Green	Apr17-May23	Jul19-Aug25				
N250	328	9.07	24	1070	118	Green	Feb21-Feb28	Mar15-Mar24	Apr15-May07	May18-Jul24	Aug05-Aug27	Sep18-Sep27
N500	328	6.44	16	470	73	Green	Feb06-Feb27	Mar14-Apr10	Sep01-Sep28	Oct15-Nov04		
N750	328	5.9	22	466	79	Green	Jan01-Jan16	Feb11-Mar06	Oct06-Oct31	Nov26-Dec31		
N1000	328	4.56	8	146	32	Green	Jan15-Feb11	Oct30-Nov26				
N1250	328	3.26	4	114	35	Green	Jan16-Jan23	Nov19-Nov26	Dec12-Dec30			
N1500	328											
NE250	328	12.22	26	1808	148	Green	Mar24-Apr07	Apr18-Aug24	Sep04-Sep18			
NE500	328	14.04	46	1994	142	Green	Feb13-Apr19	May01-May14	Jul28-Aug11	Aug23-Oct29		
NE750	328	11.63	32	930	80	Green	Jan19-Feb05	Feb17-Feb25	Mar10-Mar23	Sep18-Oct02	Oct16-Oct25	Nov05-Nov22
NE1000	328	6.59	16	652	99	Green	Jan01-Jan29	Mar01-Mar13	Jun08-Jul03	Sep29-Oct11	Nov12-Nov26	Dec07-Dec31
NE1250	328	4.24	10	212	50	Green	Jan16-Jan28	Feb25-Mar08	May11-May20	Jul21-Jul30	Oct04-Oct15	Nov14-Nov26
NE1500	328	3.77	8	162	43	Green	Jan17-Jan27	Feb23-Mar05	Apr28-May11	Jul31-Aug13	Oct07-Oct18	Nov14-Nov24
E250	328											
E500	328											
E750	328	6.4	10	352	55	Green	Apr28-May29	Jul12-Aug13				
E1000	328	3.06	4	110	36	Green	Apr18-May08	Aug03-Aug23				
E1250	328											
E1500	328											
SE250	328											
SE500	328											
SE750	328											
SE1000	328											
SE1250	328											
SE1500	328											

Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
S250	328											
S500	328											
S750	328											
S1000	328											
S1250	328											
S1500	328											
SW250	328											
SW500	328											
SW750	328											
SW1000	328											
SW1250	328											
SW1500	328											
W250	328											
W500	328	2.73	4	60	22	Green	May27-May29	Jun13-Jun28	Jul14-Jul16			
W750	328	2.67	4	48	18	Green	May23-Jun05	Jul07-Jul20				
W1000	328	2.33	4	28	12	Green	May14-May22	Jul21-Jul28				
W1250	328	4.51	8	212	47	Green	May09-May15	Jun03-Jul08	Jul27-Aug02			
W1500	328	3.78	6	136	36	Green	May06-May11	May27-Jun08	Jul03-Jul16	Aug01-Aug06		
NW250	328	3.73	6	56	15	Green	May03-May16	Jul26-Aug08				
NW500	328	4.65	10	186	40	Green	Mar30-Apr06	Apr22-May09	Aug02-Aug20	Sep05-Sep12		
NW750	328	3.02	8	136	45	Green	Mar12-Mar18	Apr03-Apr16	May06-May13	Jul30-Aug06	Aug25-Sep08	Sep24-Sep30
NW1000	328	2.58	6	160	62	Green	Feb29-Mar05	Mar22-Apr03	May16-May20	Jun09-Jul01	Jul23-Jul27	Sep08-Sep20
NW1250	328	2.63	6	100	38	Green	Feb20-Feb25	Mar15-Mar25	May24-May30	Jul12-Jul18	Sep16-Sep27	Oct16-Oct21
NW1500	328	2.49	4	102	41	Green	Feb14	Mar09-Mar19	May31-Jun10	Jul01-Jul11	Sep23-Oct03	Oct28

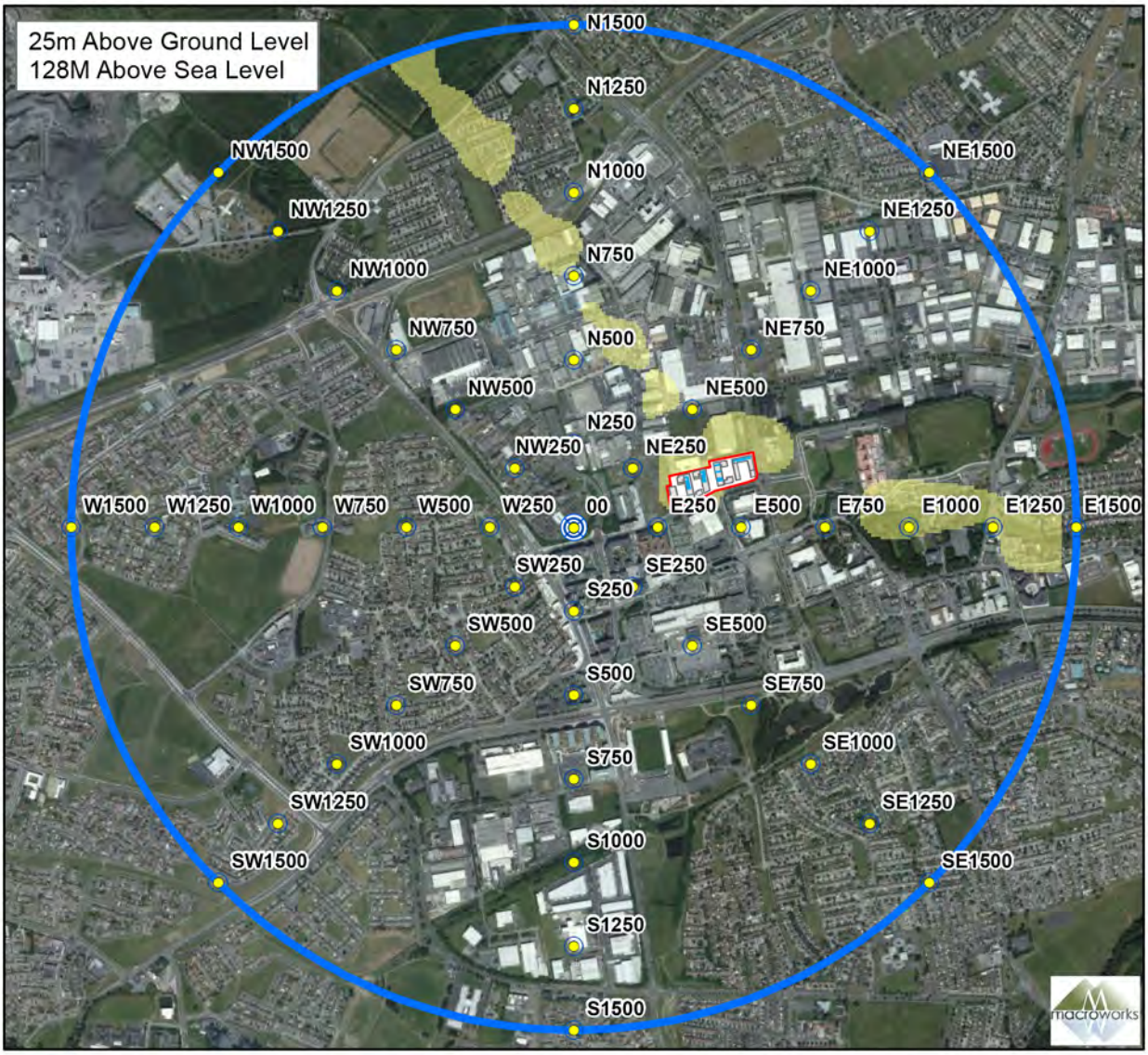
Receptor Direction & Dist 'm' relative to HeliPad	Height ASL	Average Minutes per Day of Reflectance	Maximum Minutes per Day of Reflectance	Total Minutes per Year of Reflectance	Total Days per Year of Reflectance	SGHAT Glare Intensity Rating	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6

APPENDIX D:

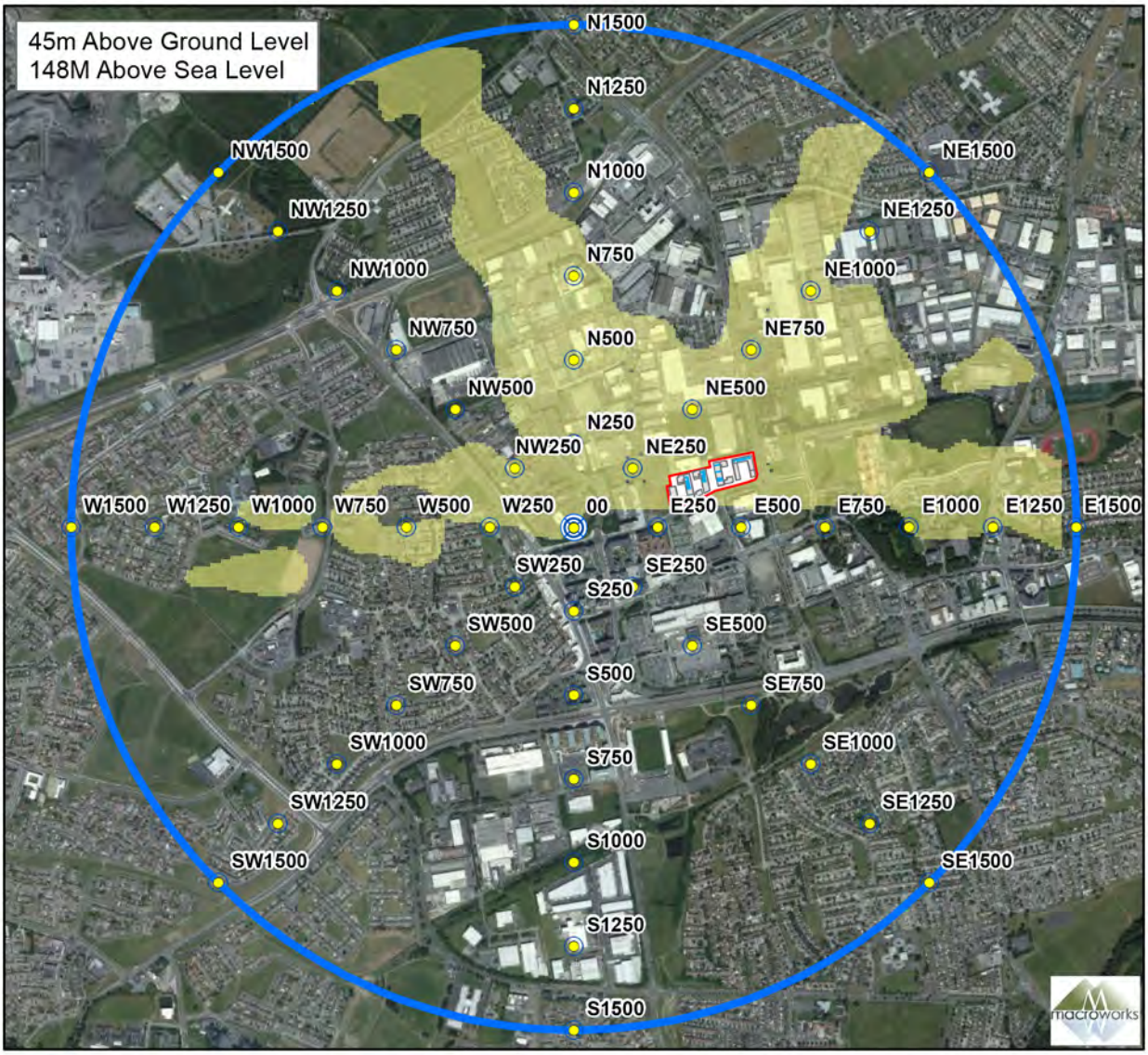
OUTPUT MAPS FROM GLINT AND GLARE MODEL ANALYSIS OF AVIATION RECEPTOR POINTS IN THE SKIES NEAR THE HELIPAD AT TALLAGHT HOSPITAL (EAST AND WEST FACING PV PANELS)



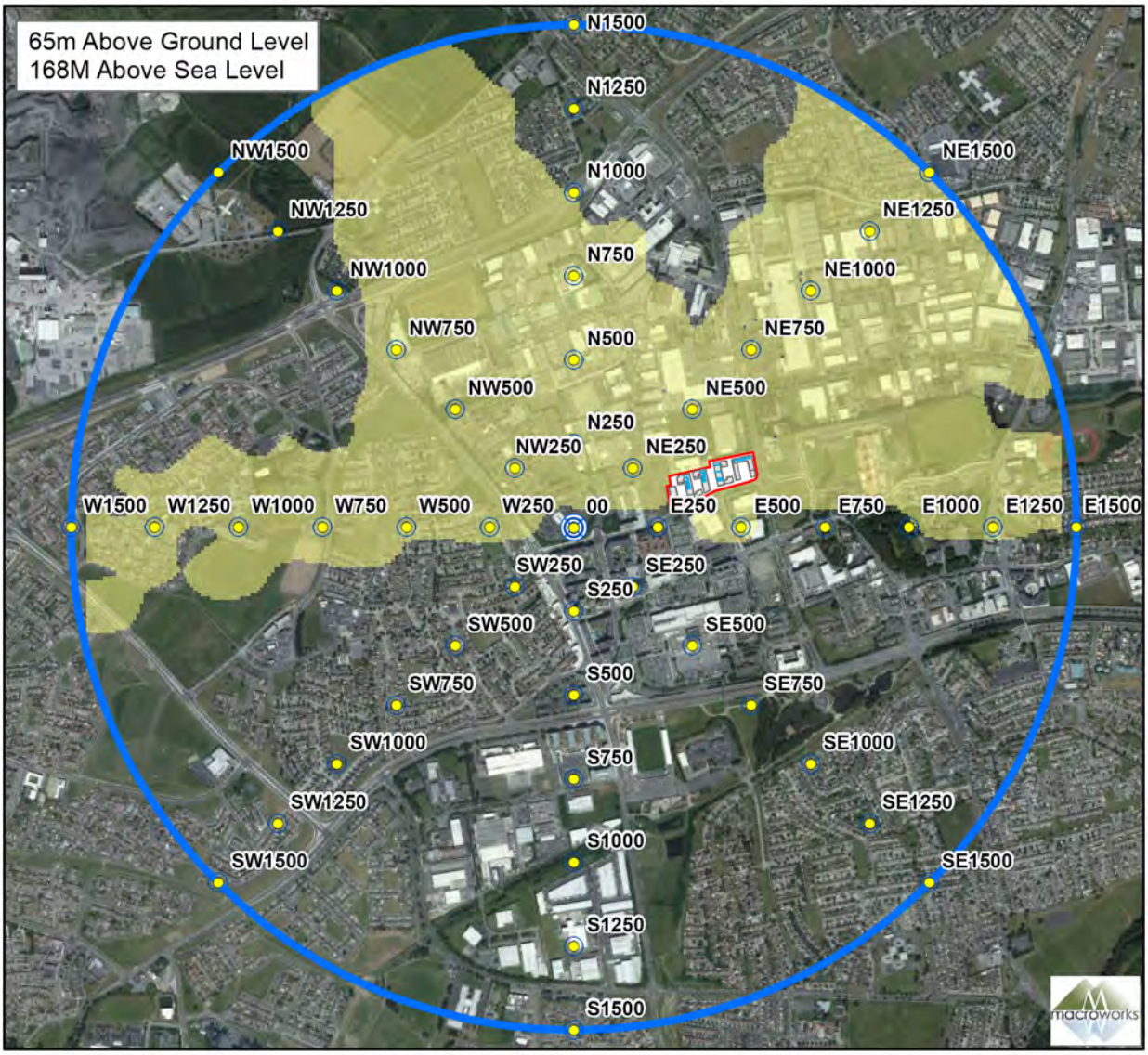
Helipad *Site Area* *Buildings* *Panels* *1.5 Km Extent* *Areas where reflectance can potentially occur*



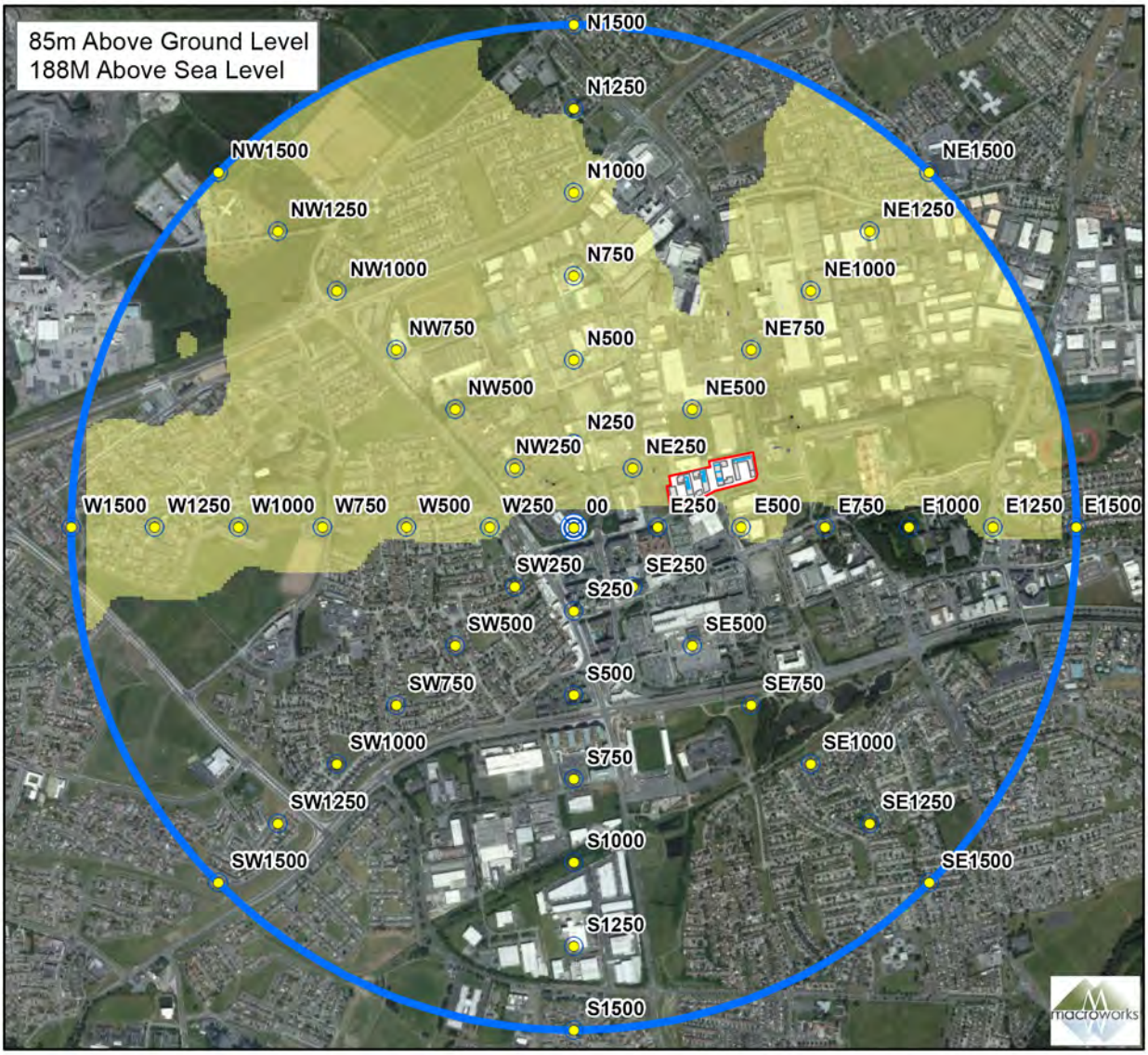
Helipad *Site Area* *Buildings* *Panels* *1.5 Km Extent* *Areas where reflectance can potentially occur*



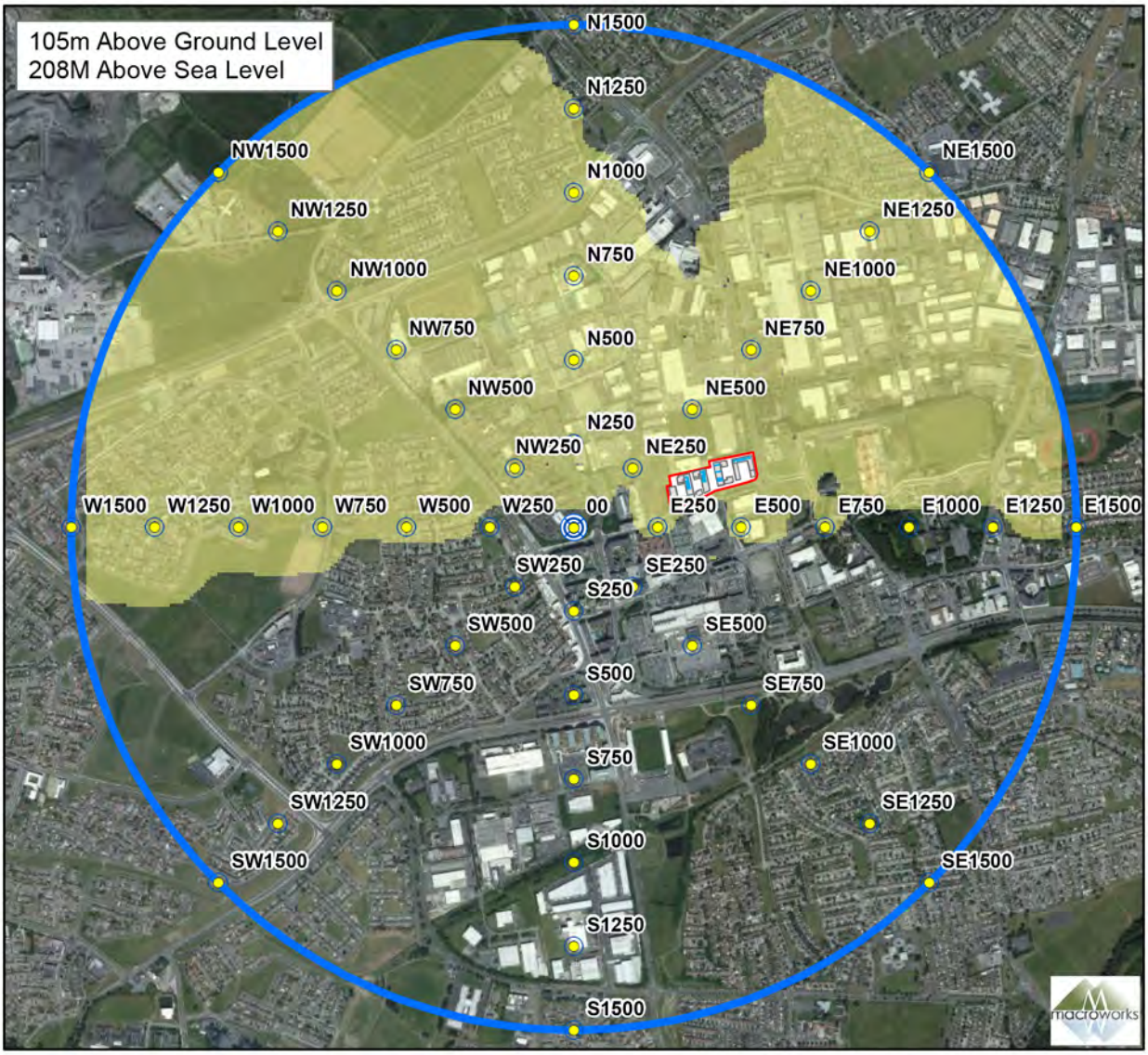
Helipad *Site Area* *Buildings* *Panels* *1.5 Km Extent* *Areas where reflectance can potentially occur*



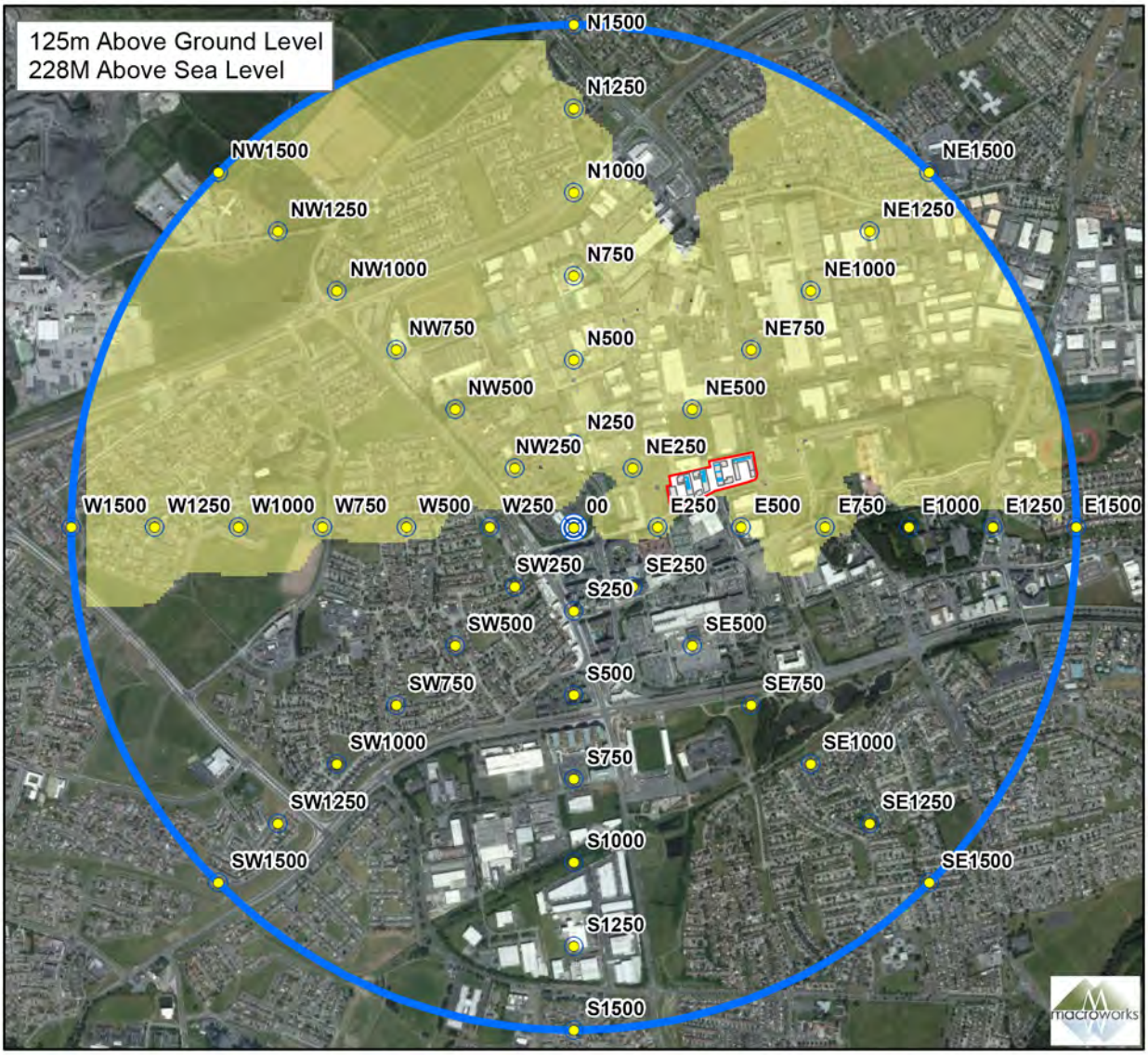
Helipad *Site Area* *Buildings* *Panels* *1.5 Km Extent* *Areas where reflectance can potentially occur*



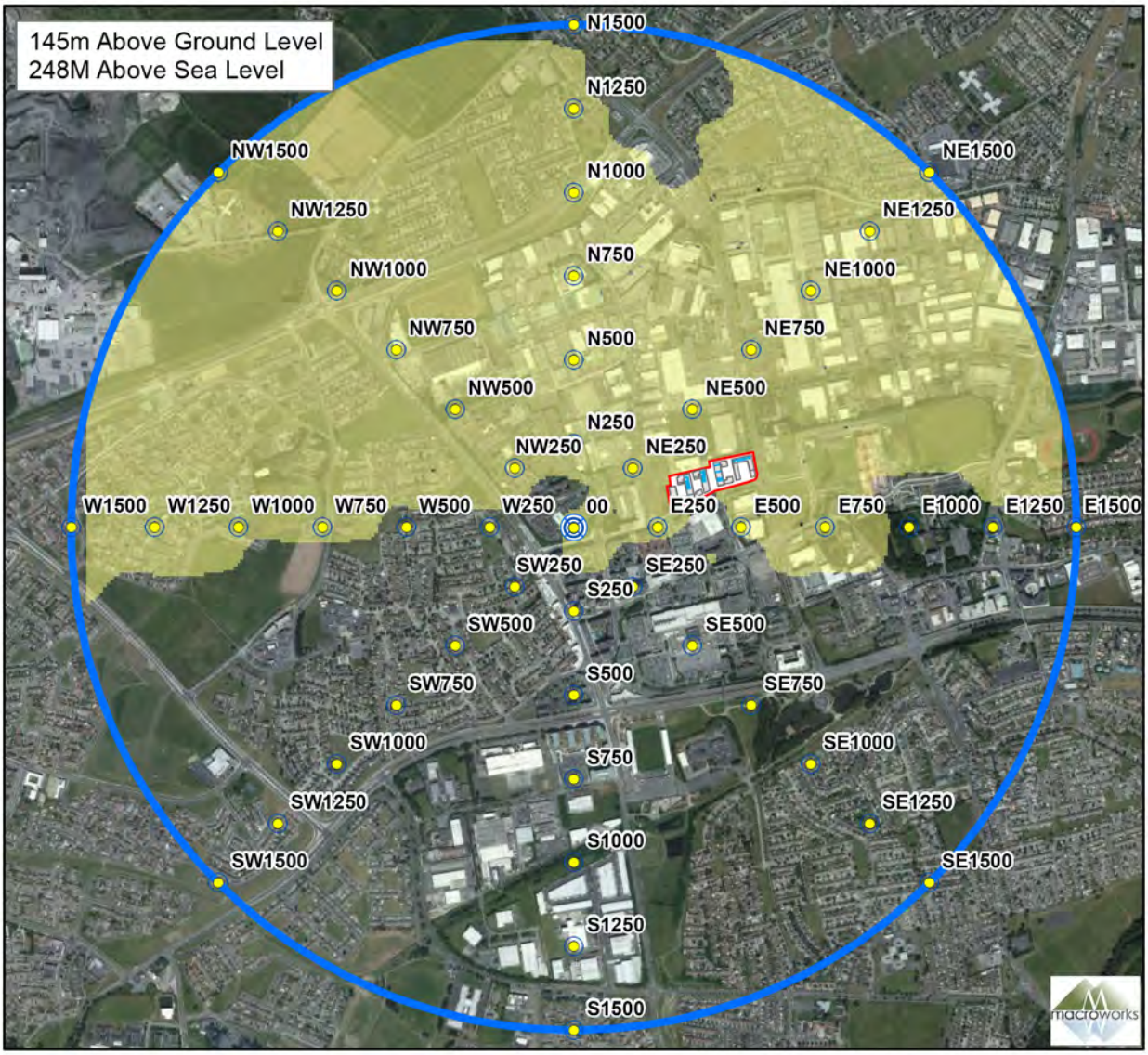
Helipad *Site Area* *Buildings* *Panels* *1.5 Km Extent* *Areas where reflectance can potentially occur*



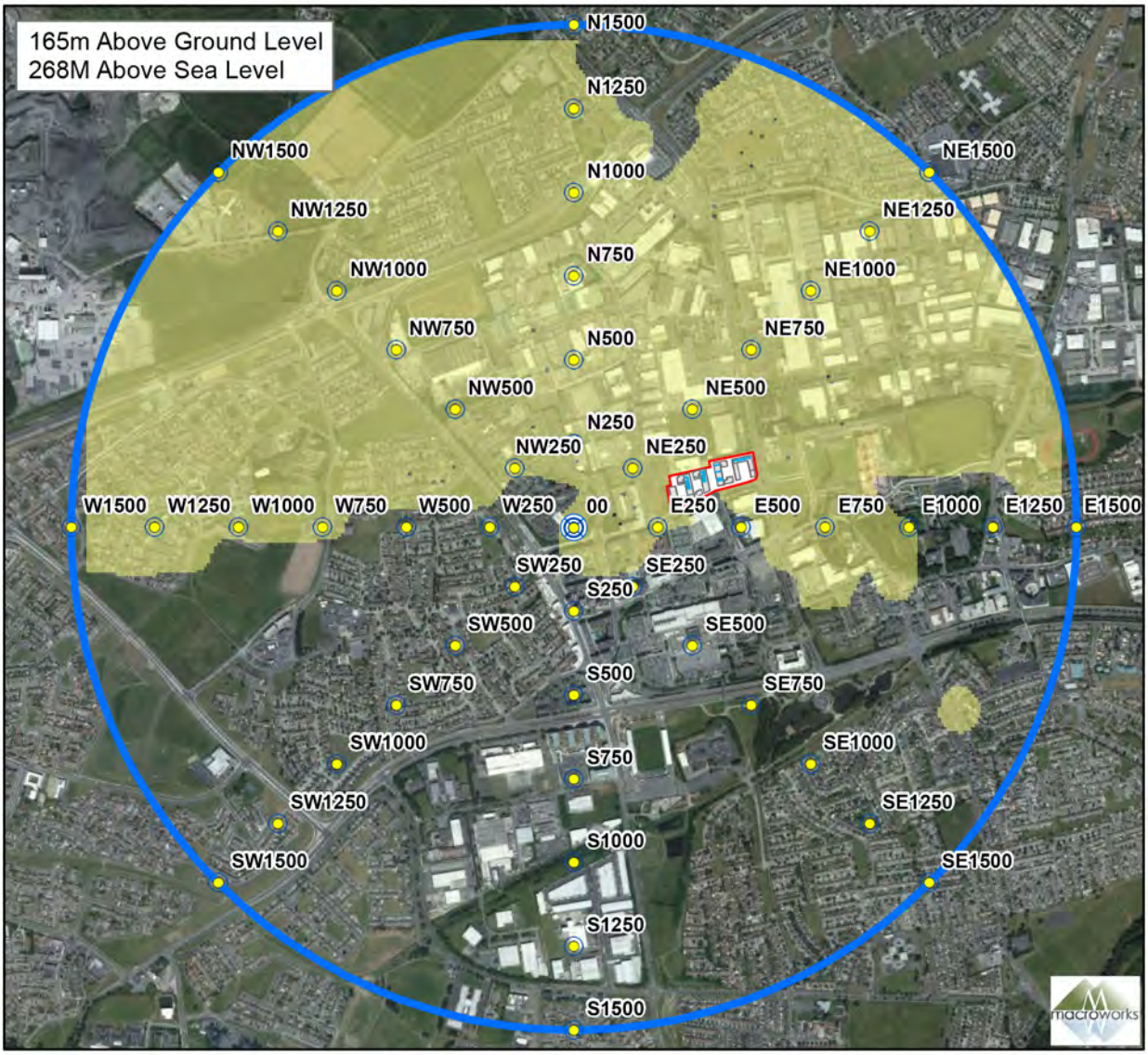
Helipad *Site Area* *Buildings* *Panels* *1.5 Km Extent* *Areas where reflectance can potentially occur*



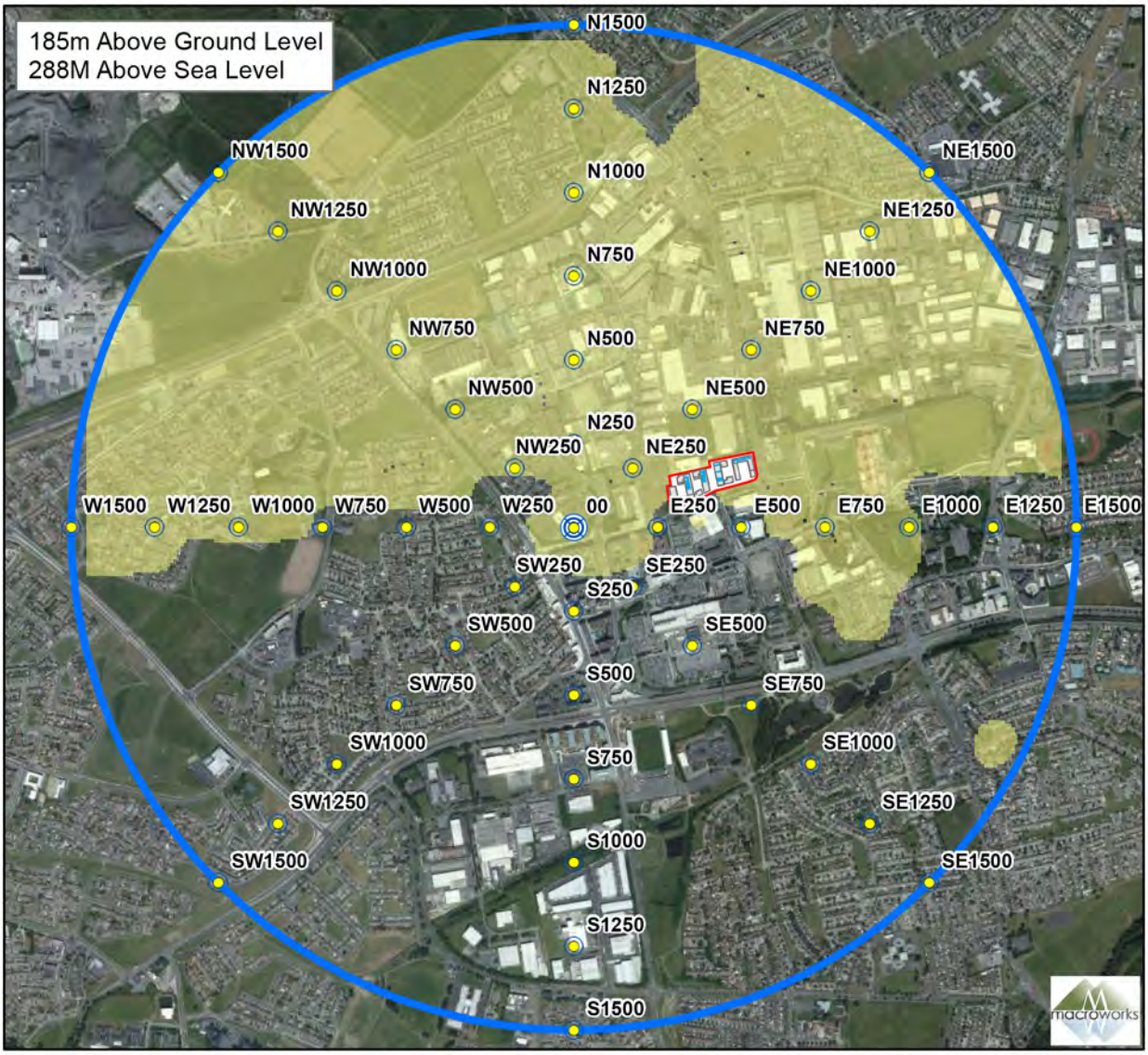
Helipad *Site Area* *Buildings* *Panels* *1.5 Km Extent* *Areas where reflectance can potentially occur*



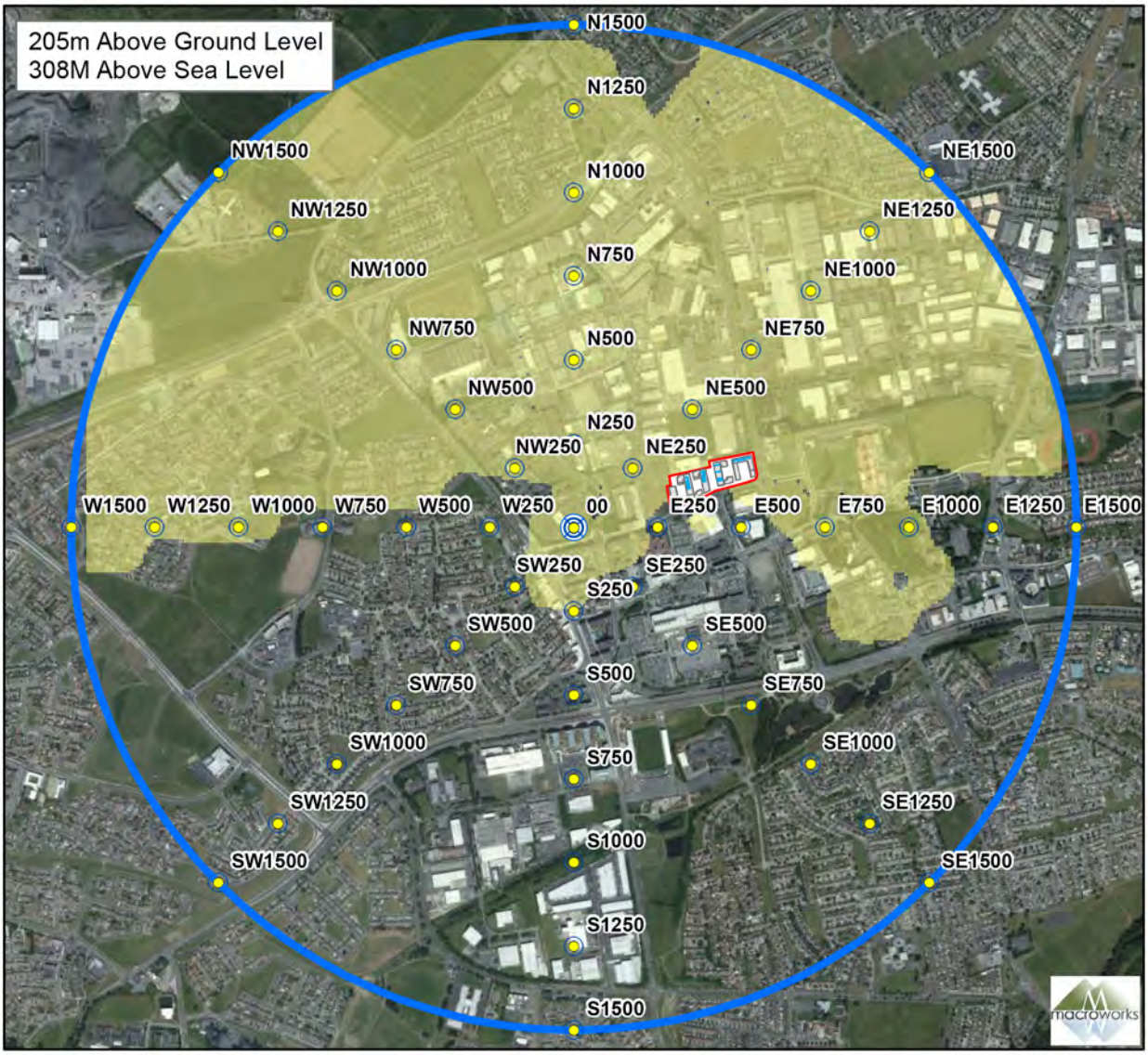
Helipad *Site Area* *Buildings* *Panels* *1.5 Km Extent* *Areas where reflectance can potentially occur*



Helipad *Site Area* *Buildings* *Panels* *1.5 Km Extent* *Areas where reflectance can potentially occur*



Helipad *Site Area* *Buildings* *Panels* *1.5 Km Extent* *Areas where reflectance can potentially occur*



Helipad *Site Area* *Buildings* *Panels* *1.5 Km Extent* *Areas where reflectance can potentially occur*

APPENDIX E:

SGHAT REPORTS OF OBSERVATION POINTS IN THE SKIES IN THE VICINITY OF THE HELIPAD AT TALLAGHT HOSPITAL (EAST AND WEST FACING PV PANELS)

SGHAT Receptors are named as Observation Points (prefixed with 'OP').

These have been positioned as per the cardinal points for the reflectance analysis.

Only those points that have demonstrated the potential for reflectance have been included in this analysis.

Receptor Points	SGHAT Points (OPs)
0	OP1
N250	OP2
N500	OP3
N750	OP4
N1000	OP5
N1250	OP6
N1500	OP7
NE250	OP8
NE500	OP9
NE750	OP10
NE1000	OP11
NE1250	OP12
NE1500	OP13
E250	OP14
E500	OP15
E750	OP16
E1000	OP17

Receptor Points	SGHAT Points (OPs)
E1250	OP18
E1500	OP19
SE250	OP20
S250	OP21
SW250	OP22
W250	OP23
W500	OP24
W750	OP25
W1000	OP26
W1250	OP27
W1500	OP28
NW250	OP29
NW500	OP30
NW750	OP31
NW1000	OP32
NW1250	OP33
NW1500	OP34

FORGESOLAR GLARE ANALYSIS

Project: **Belgard Gardens**
Site configuration: **Belgard Gardens 80Deg 168MASL**
Analysis conducted by Nikolas Hennessy (nik@macroworks.ie) at 10:50 on 31 Oct, 2018.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	N/A	No flight paths analyzed
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis and observer eye characteristics are as follows:

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Panel Area 1	10.0	80.0	5,614	0	-
Panel Area 2	10.0	80.0	1,143	0	-
Panel Area 3	10.0	80.0	1,489	0	-
Panel Area 4	10.0	80.0	1,529	0	-
Panel Area 5	10.0	80.0	1,366	0	-
Panel Area 6	10.0	80.0	4,105	0	-
Panel Area 7	10.0	80.0	4,785	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
OP 4	0	0
OP 5	0	0
OP 6	0	0
OP 7	0	0
OP 8	277	0
OP 9	11639	0
OP 10	5284	0
OP 11	1442	0
OP 12	515	0
OP 13	159	0
OP 14	0	0
OP 15	0	0
OP 16	0	0
OP 17	129	0
OP 18	322	0
OP 19	264	0
OP 20	0	0
OP 21	0	0
OP 22	0	0

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
OP 23	0	0
OP 24	0	0
OP 25	0	0
OP 26	0	0
OP 27	0	0
OP 28	0	0
OP 29	0	0
OP 30	0	0
OP 31	0	0
OP 32	0	0
OP 33	0	0
OP 34	0	0

FORGESOLAR GLARE ANALYSIS

Project: **Belgard Gardens**
Site configuration: **Belgard Gardens 260Deg 168MASL**
Analysis conducted by Nikolas Hennessy (nik@macroworks.ie) at 12:47 on 31 Oct, 2018.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	N/A	No flight paths analyzed
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis and observer eye characteristics are as follows:

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Panel Area 1	10.0	260.0	5,168	0	-
Panel Area 2	10.0	260.0	4,204	0	-
Panel Area 3	10.0	260.0	3,804	0	-
Panel Area 4	10.0	260.0	2,460	0	-
Panel Area 5	10.0	260.0	1,280	0	-
Panel Area 6	10.0	260.0	8,282	0	-
Panel Area 7	10.0	260.0	8,181	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
OP 1	0	0
OP 2	2587	0
OP 3	1433	0
OP 4	1107	0
OP 5	209	0
OP 6	29	0
OP 8	11716	0
OP 9	10955	0
OP 10	0	0
OP 11	0	0
OP 12	0	0
OP 14	0	0
OP 15	1434	0
OP 16	7	0
OP 17	0	0
OP 18	0	0
OP 20	0	0
OP 21	0	0
OP 22	0	0
OP 23	563	0
OP 24	471	0
OP 25	270	0

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
OP 26	163	0
OP 27	83	0
OP 29	1518	0
OP 30	497	0
OP 31	190	0
OP 32	90	0
OP 33	57	0

FORGESOLAR GLARE ANALYSIS

Project: **Belgard Gardens**
Site configuration: **Belgard Gardens 80Deg 248MASL**
Analysis conducted by Nikolas Hennessy (nik@macroworks.ie) at 12:42 on 31 Oct, 2018.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	N/A	No flight paths analyzed
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis and observer eye characteristics are as follows:

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Panel Area 1	10.0	80.0	8,148	0	-
Panel Area 2	10.0	80.0	3,937	0	-
Panel Area 3	10.0	80.0	2,699	0	-
Panel Area 4	10.0	80.0	2,075	0	-
Panel Area 5	10.0	80.0	1,350	0	-
Panel Area 6	10.0	80.0	6,880	0	-
Panel Area 7	10.0	80.0	8,989	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
OP 1	611	0
OP 2	1289	0
OP 3	3117	0
OP 4	2	0
OP 5	0	0
OP 6	0	0
OP 7	0	0
OP 8	7905	0
OP 9	9941	0
OP 10	4846	0
OP 11	2142	0
OP 12	955	0
OP 13	498	0
OP 14	2502	0
OP 15	0	0
OP 16	0	0
OP 17	0	0
OP 18	0	0
OP 19	270	0
OP 20	0	0
OP 21	0	0
OP 22	0	0

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
OP 23	0	0
OP 24	0	0
OP 25	0	0
OP 26	0	0
OP 27	0	0
OP 28	0	0
OP 29	0	0
OP 30	0	0
OP 31	0	0
OP 32	0	0
OP 33	0	0
OP 34	0	0

FORGESOLAR GLARE ANALYSIS

Project: **Belgard Gardens**
Site configuration: **Belgard Gardens 260Deg 248MASL**
Analysis conducted by Nikolas Hennessy (nik@macroworks.ie) at 12:58 on 31 Oct, 2018.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	N/A	No flight paths analyzed
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis and observer eye characteristics are as follows:

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Panel Area 1	10.0	260.0	11,335	0	-
Panel Area 2	10.0	260.0	5,092	0	-
Panel Area 3	10.0	260.0	3,662	0	-
Panel Area 4	10.0	260.0	3,055	0	-
Panel Area 5	10.0	260.0	2,050	0	-
Panel Area 6	10.0	260.0	8,013	0	-
Panel Area 7	10.0	260.0	9,738	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
OP 1	0	0
OP 2	6639	0
OP 3	2315	0
OP 4	1718	0
OP 5	1311	0
OP 6	291	0
OP 8	1738	0
OP 9	10208	0
OP 10	6011	0
OP 11	0	0
OP 12	0	0
OP 14	0	0
OP 15	0	0
OP 16	4497	0
OP 17	31	0
OP 18	0	0
OP 20	0	0
OP 21	0	0
OP 22	0	0
OP 23	0	0
OP 24	403	0
OP 25	580	0

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
OP 26	460	0
OP 27	327	0
OP 29	4207	0
OP 30	1172	0
OP 31	527	0
OP 32	323	0
OP 33	187	0

FORGESOLAR GLARE ANALYSIS

Project: **Belgard Gardens**
Site configuration: **Belgard Gardens 80Deg 328MASL**
Analysis conducted by Nikolas Hennessy (nik@macroworks.ie) at 13:12 on 31 Oct, 2018.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	N/A	No flight paths analyzed
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis and observer eye characteristics are as follows:

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Panel Area 1	10.0	80.0	9,772	0	-
Panel Area 2	10.0	80.0	5,676	0	-
Panel Area 3	10.0	80.0	4,251	0	-
Panel Area 4	10.0	80.0	3,401	0	-
Panel Area 5	10.0	80.0	2,283	0	-
Panel Area 6	10.0	80.0	12,824	0	-
Panel Area 7	10.0	80.0	15,206	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
OP 1	5788	0
OP 2	4057	0
OP 3	3734	0
OP 4	3928	0
OP 5	1430	0
OP 6	0	0
OP 8	12650	0
OP 9	9657	0
OP 10	4788	0
OP 11	2318	0
OP 12	1219	0
OP 14	0	0
OP 15	0	0
OP 16	0	0
OP 17	0	0
OP 18	0	0
OP 20	0	0
OP 21	1033	0
OP 22	892	0
OP 23	369	0
OP 24	0	0
OP 25	0	0

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
OP 26	0	0
OP 27	0	0
OP 29	1415	0
OP 30	135	0
OP 31	0	0
OP 32	0	0
OP 33	0	0

FORGESOLAR GLARE ANALYSIS

Project: **Belgard Gardens**
Site configuration: **Belgard Gardens 260Deg 328MASL**
Analysis conducted by Nikolas Hennessy (nik@macroworks.ie) at 13:00 on 31 Oct, 2018.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

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COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	N/A	No flight paths analyzed
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis and observer eye characteristics are as follows:

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Panel Area 1	10.0	260.0	11,663	0	-
Panel Area 2	10.0	260.0	6,407	0	-
Panel Area 3	10.0	260.0	4,035	0	-
Panel Area 4	10.0	260.0	3,040	0	-
Panel Area 5	10.0	260.0	1,758	0	-
Panel Area 6	10.0	260.0	12,050	0	-
Panel Area 7	10.0	260.0	12,052	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
OP 1	0	0
OP 2	6130	0
OP 3	2899	0
OP 4	1765	0
OP 5	1833	0
OP 6	1101	0
OP 8	0	0
OP 9	10798	0
OP 10	7522	0
OP 11	3785	0
OP 12	0	0
OP 14	0	0
OP 15	0	0
OP 16	6848	0
OP 17	2078	0
OP 18	44	0
OP 20	0	0
OP 21	0	0
OP 22	0	0
OP 23	0	0
OP 24	0	0
OP 25	255	0

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
OP 26	466	0
OP 27	360	0
OP 29	1697	0
OP 30	1899	0
OP 31	778	0
OP 32	454	0
OP 33	293	0